APRIL, 1956

RUBBER WORLD

Contents, page 55

NOW IN ITS 67th YEAR

SPECIFICATIONS FOR A RUBBER CHEMIST

R. P. Dinsmore's ACS Rubber Division 1955 Goodyear Medal Address, page 57

A BILL BROTHERS PUBLICATION

For Open-Cell Sponge

USE

UNICEL S

Specially prepared sodium bicarbonate, finely ground in mineral oil

- Disperses easily and thoroughly
- Gives uniform open-cell structure
- Economical to use
- Activates with Retarder W or Stearic Acid

FOR CLOSED-CELL SPONGE, USE "UNICEL" ND

E. I. du Pont de Nemours & Co. (Inc.)
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RUBBER CHEMICALS

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

RUBBER WORLD, April, 1956, Vol. 134, No. 1. Published monthly by BILL BROTHERS PUBLISHING CORP. Office of Publication, 1309 Noble Street, Philadelphia, Pa., with Editorial and Executive Offices at 386 Fourth Avenue, New York 16, N. Y., U.S.A. Entered as Second Class Matter at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription United States $5.00 per year; Canada, $6.00. All other countries $7.00. Single Copies 50 cents. Address Mail to N. Y. Office.

Another new development using

B.F.Goodrich Chemical *raw materials*

HYCAR AMERICAN RUBBER CAN BE TAILORED TO YOUR REQUIREMENTS

If this is your problem:

You need a flexible material that is highly resistant to aromatic fuels, oils and solvent. The answer is Hycar 1041, a high acrylonitrile copolymer rubber—used in oil well parts, fuel cell liners, fuel hose, gaskets, O-rings, cements and adhesives. —***Hycar*** 1041

Your product needs to stand up in the presence of water, while also offering good oil resistance. Hycar 1042, a medium acrylonitrile copolymer, gives this combination—extremely useful for shoe soles, kitchen mats, sink topping and printing rolls. —***Hycar*** 1042

Or you must have a rubber that retains many of these other properties even at low temperatures. Hycar 1043 is a medium low acrylonitrile copolymer meeting these requirements, and easy to process. —***Hycar*** 1043

If low temperatures make your problem critical, Hycar 1014 may be the answer. It's a low acrylonitrile copolymer especially designed to emphasize this property. —***Hycar*** 1014

These are but a few of the many Hycar American rubbers that are tailored to meet specific requirements. Literature is available listing the properties of standard materials. For copies write Dept. ES-4, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Hycar
Reg. U.S. Pat. Off.
American Rubber

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

PHILBLACK® passes rigid inspections for uniformity!

There's no "grab-bag" uncertainty when you use the Philblacks. You know what you're getting every time, because the Philblacks are manufactured to high standards of uniformity from carefully controlled feed stocks.

Constant quality controls . . . evaluation tests . . . checks and rechecks in the plant and in the Philblack laboratories, *during the entire process of production,* assure you of accurate, uniform results when you use Philblack in your recipe.

The Philblacks are famous for their versatility. If you need a special characteristic in your finished product, a Philblack is right for your purpose. Your Philblack technical sales representative will be glad to help you. Call on him for information and assistance with your carbon black problems.

Meet the Philblacks! DISCOVER WHAT THEY'LL DO FOR YOU!

Philblack A FEF Fast Extrusion Furnace Black
Ideal for smooth tubing, accurate molding, satiny finish. Mixes easily. High, hot tensile. Disperses heat. Non-staining.

Philblack I ISAF Intermediate Super Abrasion Furnace Black
Superior abrasion resistance at moderate cost. Very high resistance to cuts and cracks. More tread miles at high speeds.

Philblack O HAF High Abrasion Furnace Black
For long, durable life. Good electrical conductivity. Excellent flex. Fine dispersion.

Philblack E SAF Super Abrasion Furnace Black
Toughest black on the market. Extreme abrasion resistance. Withstands aging, cracking, cutting and chipping.

PHILLIPS CHEMICAL COMPANY, Rubber Chemicals Division, 318 Water St., Akron 8, Ohio. Export Sales: 80 Broadway, New York 5, N. Y.
West Coast: Harwick Standard Chemical Company, Los Angeles, California.

Naugatuck's B-L-E Antioxidant

Protects Brand Reputations, too!

A reputation for building tires or mechanical rubber goods that *last* can be your biggest asset! And there's no better way to protect it—or your products—than by using Naugatuck's B-L-E, *the universal antioxidant and stabilizer* for all natural and synthetic rubbers!

B-L-E provides outstanding protection against flex-cracking and the degradation caused by heat and oxygen. It prevents breakdown of rubber products at temperature extremes by preventing the elastomer from becoming either too brittle or too soft.

A free-flowing liquid, B-L-E disperses quickly and easily in rubber compounds and is very effective at *low concentrations.* Two parts per 100 RHC gives maximum flex-cracking resistance. Proved—and constantly improved—during the past 25 years, B-L-E provides the finest anti-aging qualities in rubber products where discoloration is not a factor. Why not let it protect the reputation of *your* brand of rubber products?

In polymer plants, B-L-E®, added as an emulsion to RS latex, is retained in the polymer during and after flocculation and drying to protect it against resinification and subsequent heat and oxidative deterioration.

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

IN CANADA: NAUGATUCK CHEMICALS DIVISION • Dominion Rubber Company, Limited, Elmira, Ontario
RUBBER CHEMICALS • SYNTHETIC RUBBER • PLASTICS • AGRICULTURAL CHEMICALS • RECLAIMED RUBBER • LATICES • Cable Address: Rubexport, N.Y.

a case of jointe

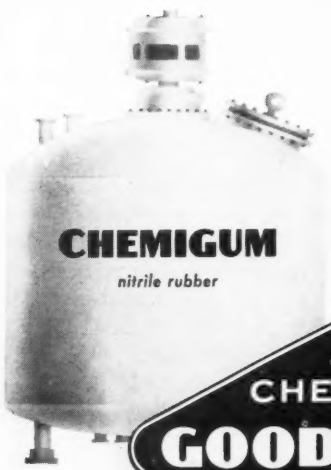
A string of hundreds of joints of drill pipe is as flexible as a fine steel wire. If uncontrolled, it rubs and slams against the casing–causes costly, premature wear and damage.

To protect their investment in pipe, casing and tool joints, drillers first placed tough, thick collars of natural rubber at intervals on the pipe. These served as efficient spacers and protectors despite the extreme abuse and abrasion.

But the advent of oil-based drilling muds brought a new problem: The natural rubber quickly swelled and deteriorated.

To meet this new service requirement, an enterprising specialty molding company, working jointly with all concerned, developed a new compound based on CHEMIGUM–the easy processing nitrile rubber.

The excellent oil-resistance of CHEMIGUM plus its ability to be cured without sulfur made possible an "all-purpose" protector which: 1. Effectively resists the chemical and abrasive attack of both oil- and clay-base drilling fluids. 2. Exhibits minimum oil-absorption characteristics. 3. Resists the effects of high temperatures more than any other protector on the market. 4. Displays the high tensile and pipe-gripping qualities of natural rubber. 5. Is well lubricated by both types of mud.



The easy processing of CHEMIGUM, its lightweight bale and its excellent bin aging properties also were pleasing to the molder.

Drill pipe protectors are another example of how the extra oil-resistance and extra processability of CHEMIGUM have materially improved a product. How can they help yours? For details and the latest Tech Book Bulletin, write:

Goodyear, Chemical Division, Akron 16, Ohio

CHEMICAL GOODYEAR DIVISION

RUBBER & RUBBER CHEMICALS DEPARTMENT

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

Chemigum, Pliolite, Pliolite, Plio-Tuf, Pliovic–T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

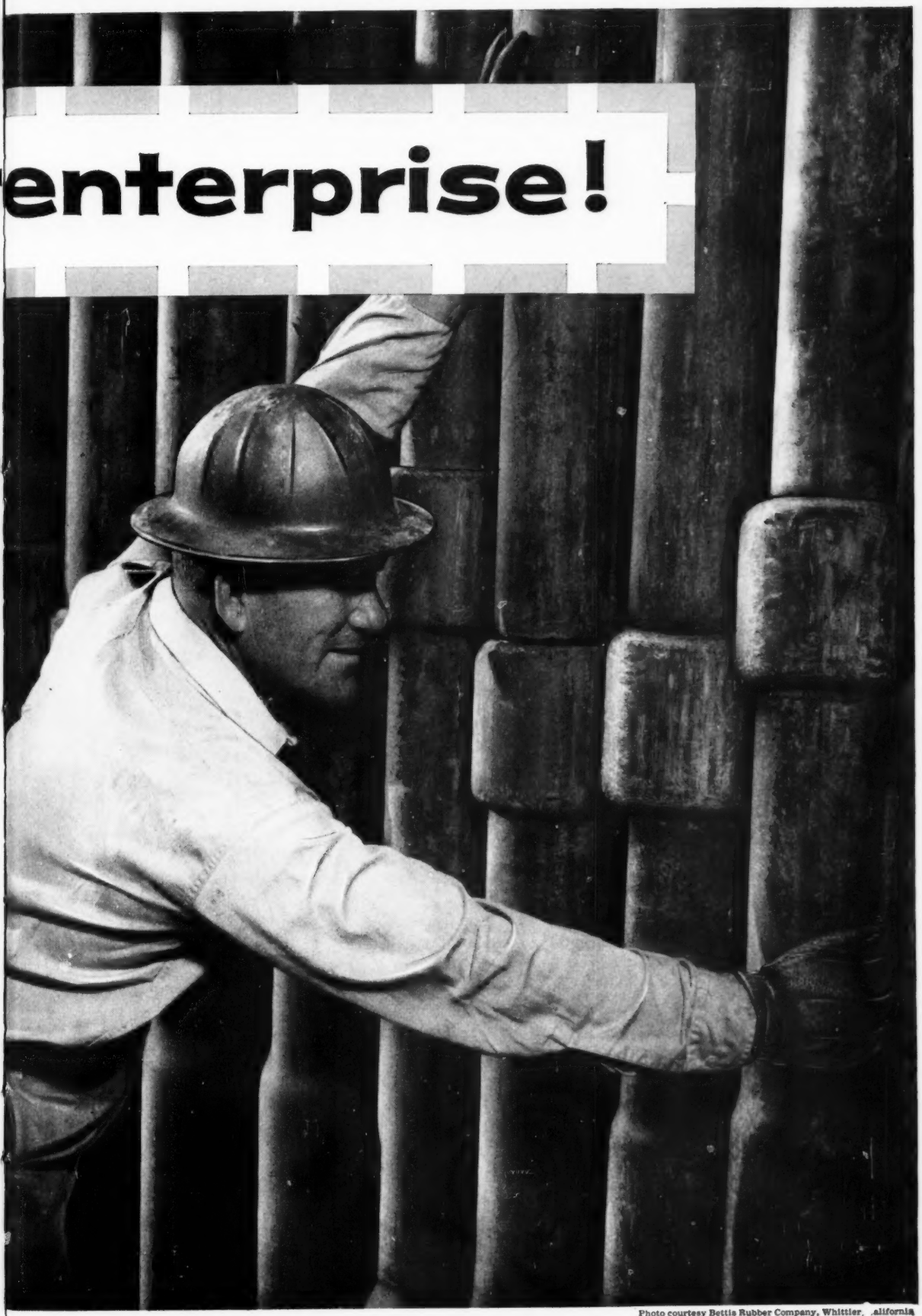


Photo courtesy Bettis Rubber Company, Whittier, alifornia

78 TON HOT PLATE PRESS

18 inch stroke; 4½ inch openings; and 14 inch by 14 inch pressing surface.

FRENCH

Another Example of the Flexibility of

FRENCH'S SIDE PLATE PRESS

Incorporating all the advantages* of our standard side plate press, this four combination press offers a compact package resulting in *saved floor space.*

* RIGIDITY
* ACCURACY
* DEPENDABILITY
* LOW MAINTENANCE

Improve your low tolerance molding with French side plate presses.

WRITE FOR ILLUSTRATED CATALOG

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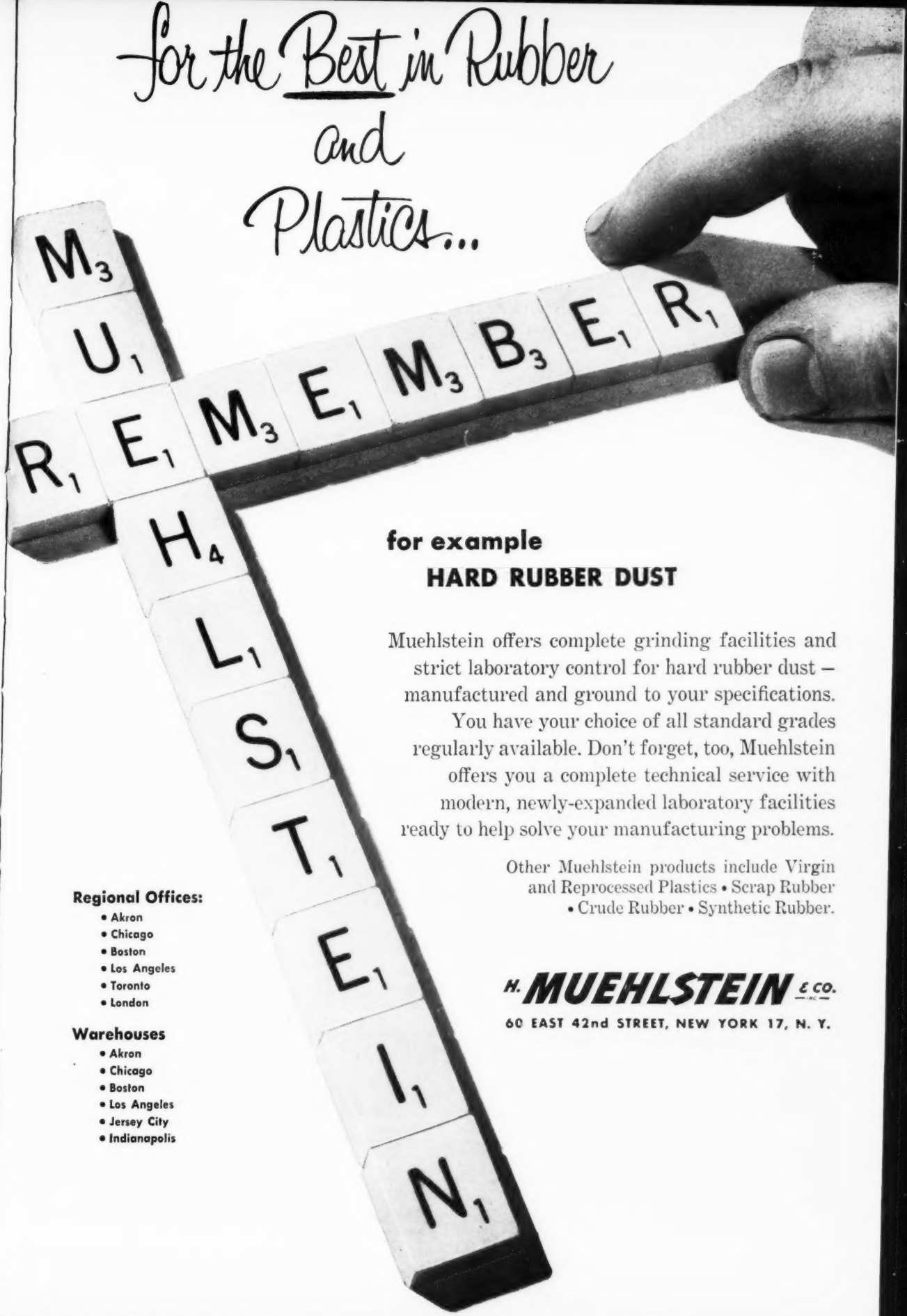
for the Best in Rubber and Plastics...



for example

HARD RUBBER DUST

Muehlstein offers complete grinding facilities and strict laboratory control for hard rubber dust – manufactured and ground to your specifications. You have your choice of all standard grades regularly available. Don't forget, too, Muehlstein offers you a complete technical service with modern, newly-expanded laboratory facilities ready to help solve your manufacturing problems.

Other Muehlstein products include Virgin and Reprocessed Plastics • Scrap Rubber • Crude Rubber • Synthetic Rubber.

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FOR TOP QUALITY PRODUCTION

Specify

Burgess Anhydrous Aluminum Silicate Pigments

USE BURGESS "ICEBERG" and "ICEBERG K" PIGMENTS

- **For Vinyl Extrusion Compounds and Vinyl Floor Covering Compounds** "Iceberg" provides excellent base color as a white mineral loading, excellent resistance to alkalis and acids, high specific resistance with low moisture absorption properties.
- **For Butyl Wire and Insulating Compounds** "Iceberg" possesses excellent processing, reinforcing, and good electrical properties.
- **For Colored Butyl Inner Tubes, Drug Sundries and Mechanical Goods** "Iceberg" possesses excellent color, processing and curing properties and low moisture absorption.
- **For GR-S Compounding** "Iceberg" is useful in compounds requiring good white filler with good processing properties, i.e., "Iceberg" prevents stickiness on the mill and also prevents die-plating of extrusion compounds.

USE BURGESS "NO. 30" and "30 K" PIGMENTS

- **For Vinyl Insulating and Electrical Compounds** No. 30 possesses excellent color and yields high insulation resistance values.
- **For GR-S Compounds** No. 30 acts as a good reinforcing agent and filler with a high degree of uniformity with respect to specific resistance, low moisture absorption, good color and brightness.

USE BURGESS "PIGMENT NO. 20" (Hydrous)

- **For Natural and Synthetic Rubber Compounds** No. 20 yields level cures because of controlled pH.
- **For Rubber Footwear Compounds** No. 20 possesses excellent reinforcing characteristics and good color.

Ask your Burgess representative for technical data, working samples, and prices.

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- HYDROUS AND ANHYDROUS ALUMINUM SILICATE PIGMENTS
- KAOLIN CLAYS

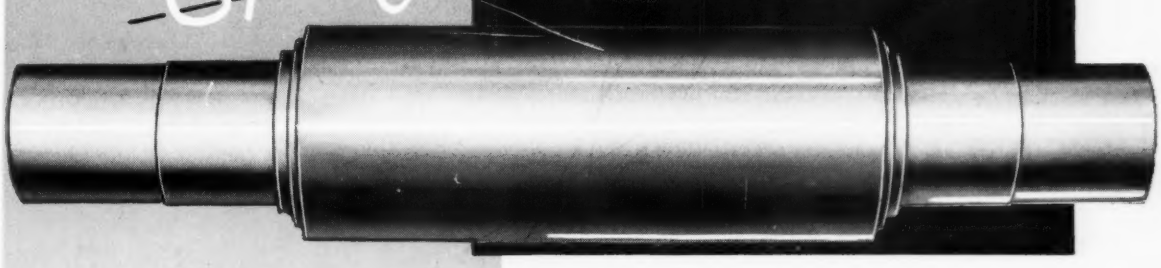
Where

UNIFORMITY
PRECISION
DEPENDABILITY
are factors . . .

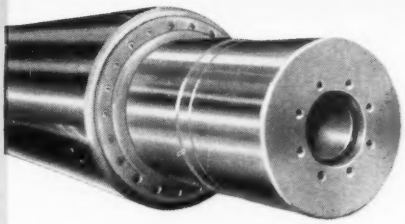
Specify

UNITED®

DRILLED-TYPE ROLLS



for the precision calendering of
PLASTICS
RUBBER
TILE
LINOLEUM
or any materials requiring close heat control



UNITED Precision Ground, DRILLED-TYPE ROLLS, the result of careful metallurgical control over raw materials, and of strict quality control in every phase of manufacture . . .

MAINTAIN A UNIFORM ROLL SURFACE TEMPERATURE throughout, with minimum deviation at any point.

ASSURE FULL RANGE HEATING and cooling over wide temperature ranges.

PROVIDE ACCURATE, QUICKLY RESPONSIVE TEMPERATURE CONTROL.

UTILIZE FULL ROLL FACE with new, ring closure type designs.

PERMIT ADJUSTMENT OF RING CLOSURE GASKET AND BOLTS, WITH ROLL IN PLACE in calender or mill, thus eliminating production downtime due to roll removal.

MAINTAIN CORRECT DEPTH OF CHILL for iron or alloy iron rolls.

ARE ENGINEERED AND DESIGNED FOR MAXIMUM HEAT TRANSFER RATE with accurately drilled, fluid passages.

Our more than 50 years experience in the design and manufacture of rolls can be helpful in solving your processing problems. Your inquiry is solicited.

UNITED

ENGINEERING AND FOUNDRY COMPANY
PITTSBURGH, PENNSYLVANIA

Plants at • Pittsburgh • Vandergrift • Youngstown • Canton • Wilmington (Lobdell United Division)

SUBSIDIARIES: Adamson United Company, Akron, Ohio
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Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

Natural Rubber . . . GR-S . . . Buna N . . . Silicones . . . Polyethylene? The above could be any of them or one of many other polymers, when versatile Di-cup is used as the curing agent.

DI-CUP* A NEW "CURE-ALL" FOR POLYMERS?

Coming off a curing press, this slab could be any of a number of materials that can be economically and efficiently cured with new Hercules Di-cup (dicumyl peroxide).

The first new widely applicable method of curing without sulfur or a sulfur-containing compound to be developed in 117 years. Di-cup produces carbon-to-carbon cross linking that makes it practically a "cure-all" for polymers.

Di-cup is a stable peroxide of low volatility. Economical to use. Di-cup vulcanizates exhibit good aging, good low temperature performance, and low compression set. White stock is not discolored and good color retention is obtained. Silicones cured with Di-cup are free of gas bubbles and acidic by-products.

Why not learn more about this new curing agent? Write to Hercules for additional data and information on available commercial forms.

Naval Stores Department

HERCULES POWDER COMPANY

INCORPORATED

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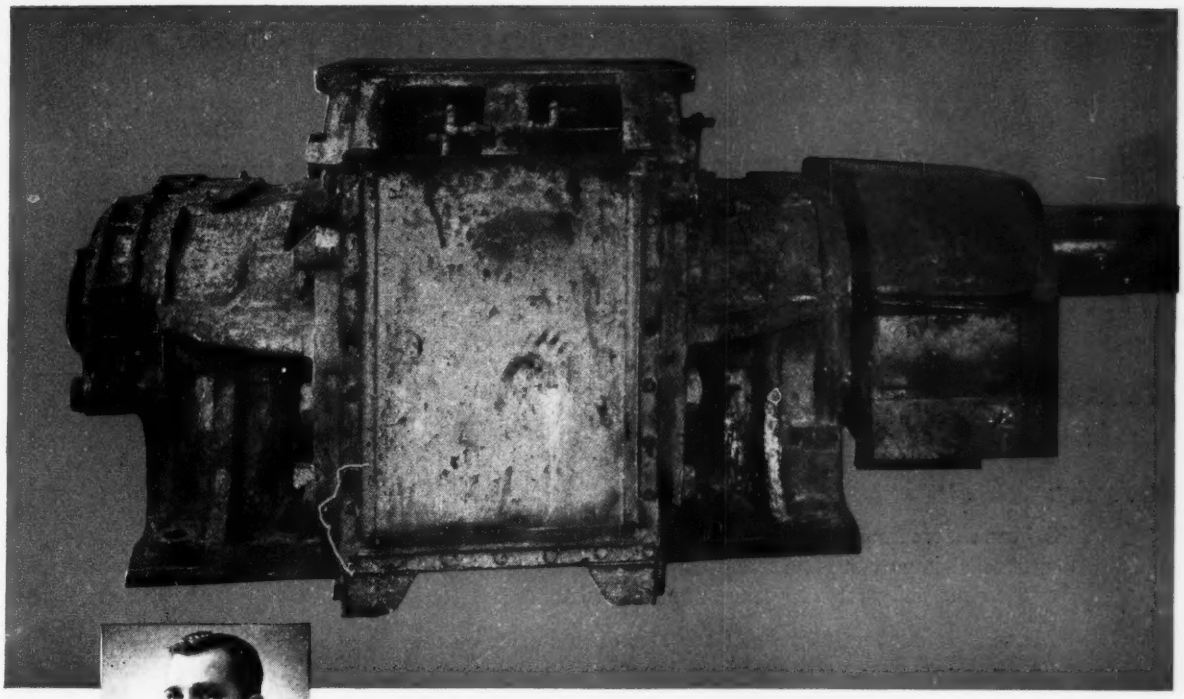
*Hercules trademark

N056-1



Walter D. Taylor

Richard E. Baker, Jr.

George O. Wilson

Alfred W. Marsch

Edward H. Shortell

When your Banbury® mixer is ailing–

CALL THE DOCTOR!

When you are ill, you call in a doctor—a man you know has the *ability* and *experience* to diagnose your ailment and prescribe a cure. Or, instead of waiting for illness to strike, you see your doctor for periodic checkups to forestall trouble.

Why not follow one of these procedures with your Banbury mixers? If a machine is "ill," call in a man with the *ability* and *experience* to tell you what is wrong and how it can be remedied — quickly and surely. Better still, schedule your Banburys for regular examinations to avoid trouble.

The photos show five such "doctors" — and all Farrel-Birmingham service engineers. Between them they have had 88 years of experience in the "anatomy" of the Banbury mixer. They are all specialists in prescribing sound preventive maintenance, or lasting cures for trouble that may have developed.

It will pay you to have one of these men make a "no-charge" checkup of your Banburys. Just contact one of the offices listed below.

FARREL-BIRMINGHAM COMPANY, INC.

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AKRON 8, OHIO, 2710 First National Tower (PArtage 2-8871)
CHICAGO 3, ILL., 120 South La Salle Street (ANdover 3-6434)
LOS ANGELES 21, CAL., 2032 Santa Fe Ave (LUdlow 5-3017)
HOUSTON 2, TEXAS, 860A M&M Building (CApitol 2-6242)
FAYETTEVILLE, N. C., P. O. Box 3157 (3-0353)

Farrel-Birmingham®

FB-1064

In Your Latex Compounds . . .

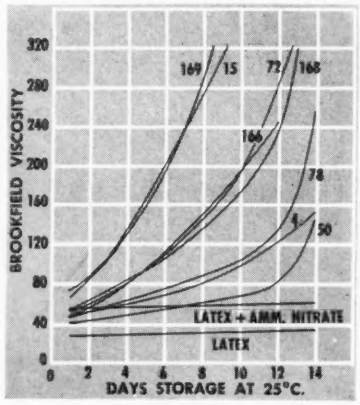
WHICH HORSE HEAD ZINC OXIDE DO YOU NEED?

Most formulators agree that zinc oxide is the most critical ingredient to select for latex use.

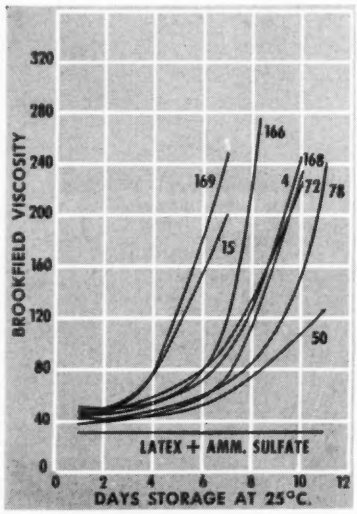
Here's why:

1. YOU can choose from many types of zinc oxides, and each type influences such important properties of latex compounds as viscosity, suspension, stability, rate of gelation and rate of cure.
2. YOU can't predict the influence of any type of zinc oxide on the properties of your latex compound . . . because the influence of a zinc oxide depends upon the specific latex formulation, as shown in the charts at right.

So . . . for best results, test the widest range of types—the Horse Head family—including the exclusive Kadox and Protox* brands.



Influence of zinc oxides on the chemical stability of latex containing 1% NH_4NO_3



Influence of zinc oxides on the chemical stability of latex containing 1% $(NH_4)_2SO_4$.

HORSE HEAD ZINC OXIDES FOR LATEX

Brand	Surface Area (Sq. M /Gm.)	Process of Mfg. American	Process of Mfg. French	Propionic Acid Surface Treatment
XX-50	3.0	✓		
XX-78	3.9		✓	
XX-4	4.4	✓		
Protox–166	4.4	✓		✓
Kadox–72	7.9		✓	
Protox–168	7.9		✓	✓
Kadox–15	10.0		✓	
Protox–169	10.0		✓	✓

*U. S. Patents 2,303,329 and 2,303,330

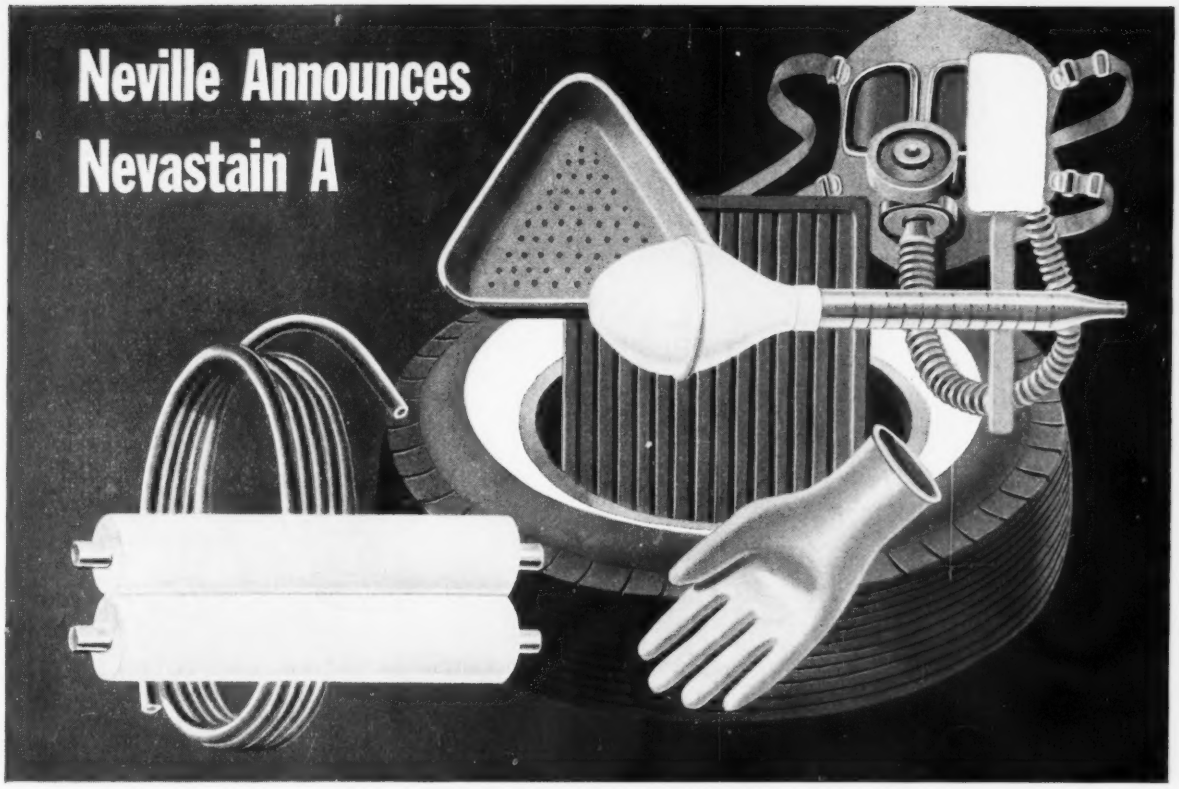
THE NEW JERSEY ZINC COMPANY

Producers of Horse Head Zinc Pigments

. . . most used by rubber manufacturers since 1852

160 Front Street, New York 38, N. Y.

HORSE HEAD PRODUCTS



A New Non-Staining Rubber Antioxidant with Superior Characteristics

Nevastain A is an excellent non-staining, non-discoloring antioxidant with very low volatility and good stability. Synthetic and natural rubber compounds using Nevastain A have superior physical characteristics over those containing competitive non-staining antioxidants. Among its virtues are that it does not retard vulcanization, does not have an accelerating effect and does not bloom uncured or cured stock when used in normal quantities. This new product is being produced on a plant scale and is readily available and attractively priced. Use the coupon below to write for Technical Service Report No. 45.

Neville Chemical Company, Pittsburgh 25, Pa.

Resins—Coumarone-Indene, Heat Reactive, Phenol Modified Coumarone-Indene, Petroleum, Alkylated Phenol • **Oils**—Shingle Stain, Neutral, Plasticizing, Rubber Reclaiming • **Solvents**—2-50 W Hi-Flash, Wire Enamel Thinners.

NEVILLE

Please send Technical Service Report No. 45.

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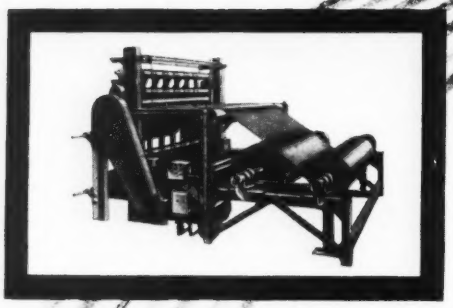
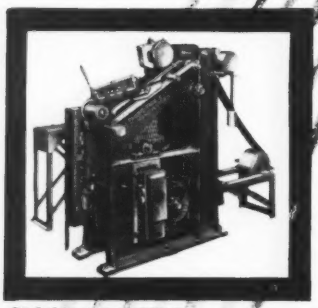
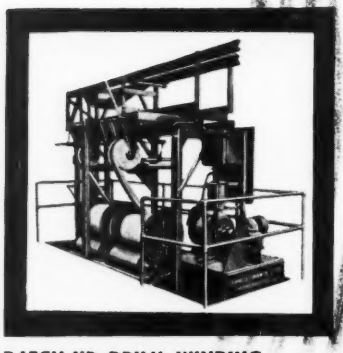


FABRIC SLITTING
at 450 yards an hour

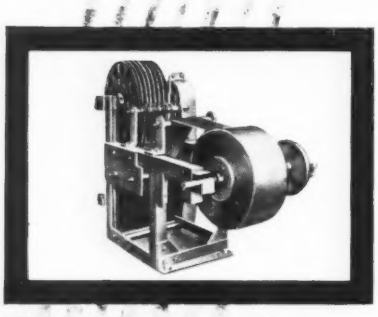
complete wire-bead CYCLE TYRES in one fast operation



SPOOL WRAPPING
to supply 4 Monoband machines

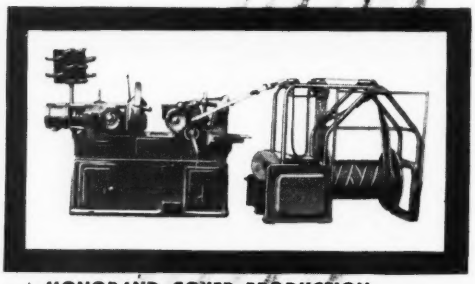


BATCH-UP DRUM WINDING
for continuous production



BEAD WIRE FABRIC SLITTING
for 1,650 tyres an hour

SHAW
MONOBAND
PROCESS



and **MONOBAND COVER PRODUCTION**
of up to 80 covers an hour

BEAD WIRE COVERING
of 300 single wires an hour

with the SHAW-SUMMIT vulcanising press

SHAW

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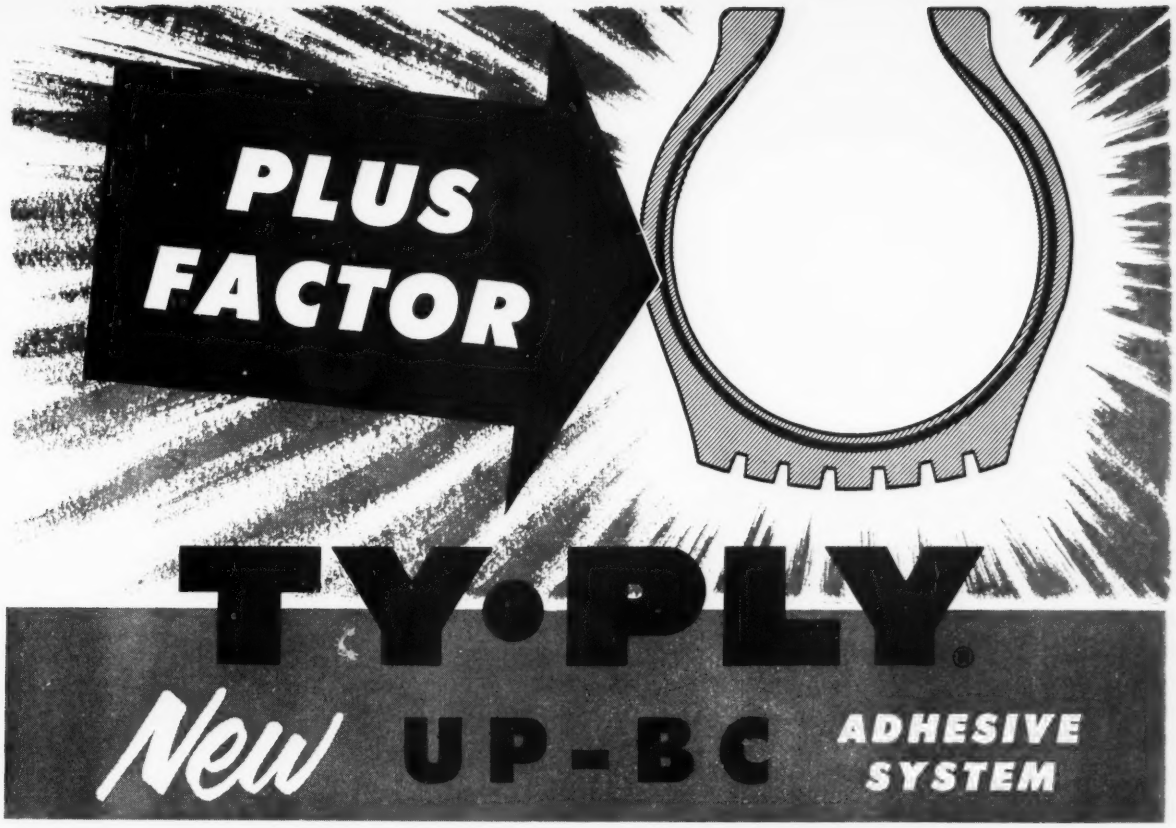

for vulcanized bonding of BUTYL sealant to other rubber compounds in tubeless tires

TY-PLY UP — the universal Primer, and TY-PLY BC, the Butyl Cover Cement, give exceptional bonds of Butyl compounds to metals regardless of cure system or type and amount of filler.

TY-PLY BC alone is an excellent adhesive for the vulcanized bonding of cured and uncured Butyl rubbers to various types of elastomeric compounds.

TY-PLY "UP-RC"
the two coat Adhesive System for bonding Natural Rubber and GR-S Compounds

TY-PLY "Q" or "3640"
the single coat Adhesive for bonding Natural and GR-S compounds

TY-PLY "BN"
for bonding N-types

TY-PLY "S"
for bonding Neoprene

TY-PLY will adhere most vulcanizable rubber compounds to almost any clean metal surface

Marbon®

MARBON CHEMICAL
Division of BORG-WARNER
GARY, INDIANA

TY-PLY has stood the test of time . . . since '39

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ST. JOE *Rubber Grade* ZnO

ST. JOE lead-free **ZINC OXIDES** are available in a complete series of grades for rubber compounds. Quality control from ore to oxide is one of St. Joe's most important production tools. This, together with prompt deliveries, unequalled and unbiased customer service, accounts for their rapidly increasing use in the industry.

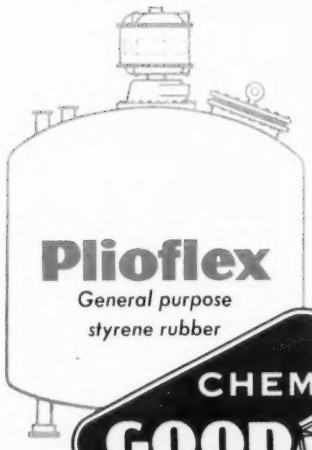
FINE PARTICLE SIZE *Fast Cure*	**Black Label #20** **Red Label #30**
MEDIUM PARTICLE SIZE *Fast Cure*	**Green Label #42, #43**
MEDIUM PARTICLE SIZE *Slow Cure*	**Green Label #42A3** **Red Label #31**
FINE PARTICLE SIZE *Surface Treated*	**Black Label #20-21**
MEDIUM PARTICLE SIZE *Surface Treated*	**Green Label #42-21**
SPECIAL GRADES FOR LATEX	**Black Label #20** **Green Label #12, #46**
PELLETIZED GRADES *Surface Treated*	**Black Label #20-21 Pellets** **Green Label #42-21 Pellets**

Complete data on all grades, and samples for testing sent on request.

ST. JOSEPH LEAD COMPANY

250 PARK AVENUE, NEW YORK 17 • Plant & Laboratory: Monaca (Josephtown) Pa.

This new product is nearly 30 years old!



YOU might say it was born in 1925. It grew slowly at first, but then very rapidly under government sponsorship. Last year it reached maturity, when it became PLIOFLEX—Goodyear Synthetic Rubber.

It was in 1925 that Goodyear began work leading to its first patent on making synthetic rubber by emulsion polymerization—the basic process in use today. Through the years, Goodyear pioneered many other advances including continuous polymerization, oil extended rubbers and nonstaining rubbers. Goodyear also put the first Government plant in operation at Houston, Texas, and operated another plant in Akron, Ohio, accumulating almost 15 years of large-scale manufacturing experience.

Today, PLIOFLEX—a family of primarily nonstaining, styrene-type rubbers—stands on the threshold of a great future. Its outstanding quality is well-known to many processors of shoe soles, flooring, wiring, mechanical goods, sporting goods, sundries and other rubber products. In a sense, PLIOFLEX is an old friend embarking on a new career. It already has made substantial progress—even more is assured by the years of experience behind it.

Further information in the free, 24-page brochure "PLIOFLEX Rubber," is yours by writing, on company letterhead, to: Goodyear, Chemical Division, Dept. P-9418, Akron 16, Ohio.

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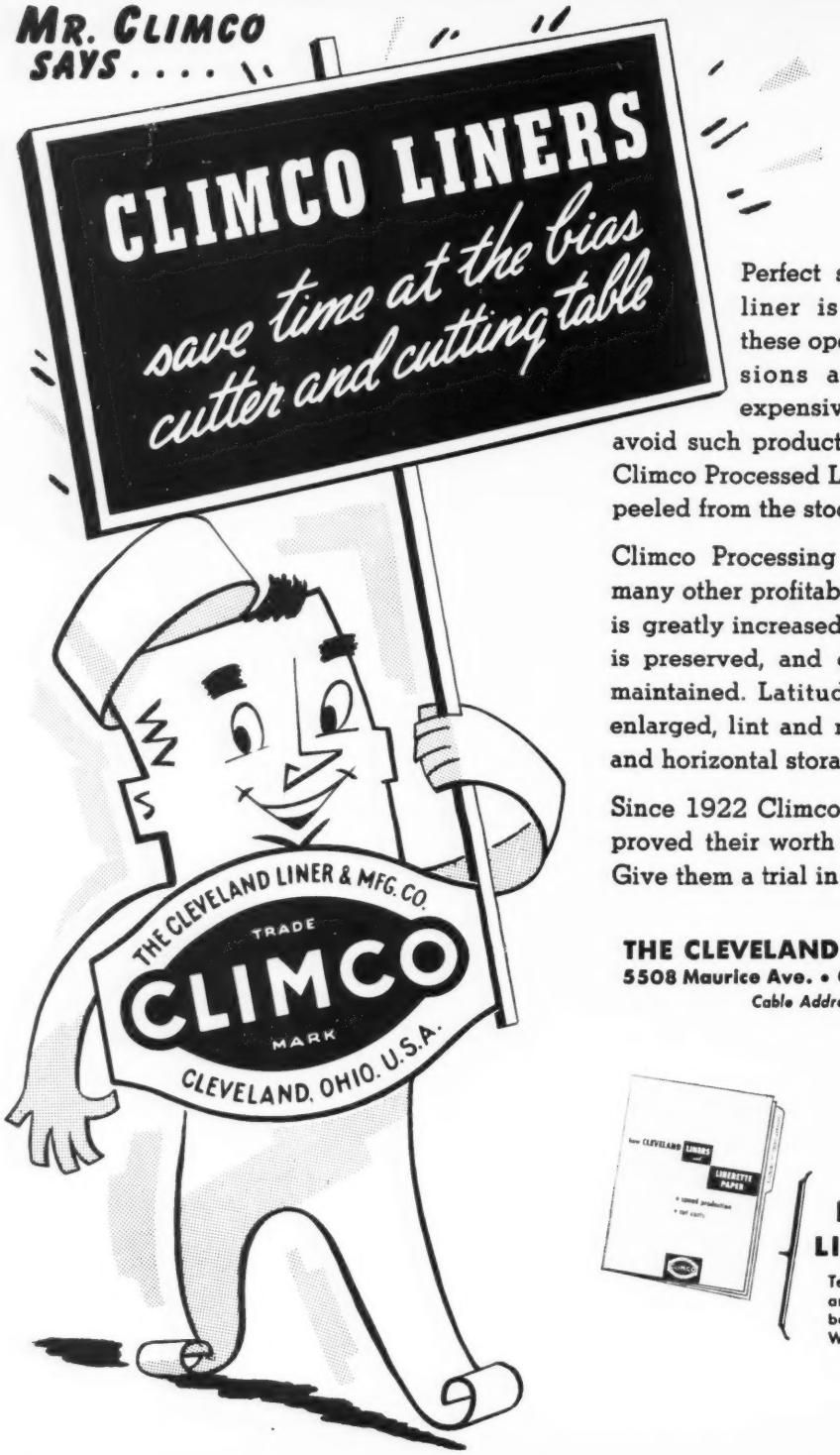
MR. CLIMCO SAYS . . . .



Perfect separation of stock and liner is all important during these operations—for stock adhesions at either point cause expensive down time. You can avoid such production headaches by using Climco Processed Liners that can be readily peeled from the stock without sticking.

Climco Processing of your liners assures many other profitable advantages: Liner life is greatly increased, tackiness of the stock is preserved, and gauges are more easily maintained. Latitude in compounding is enlarged, lint and ravelings are eliminated and horizontal storage is facilitated.

Since 1922 Climco Processed Liners have proved their worth to the rubber industry. Give them a trial in your plant.

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Cable Address: "BLUELINER"

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Tells all about Climco Liners and Linerette and how to get better service from liners. Write for your copy now.

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Serving the Industry Since 1921

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Treatment Contains
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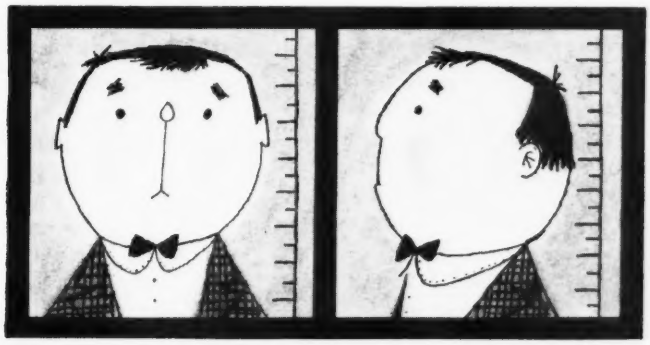

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★ **easier processing...** *smoother milling, better calendering, more uniform cures.*

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★ **lower materials costs...** *higher loading of resin with no degradation of quality.*

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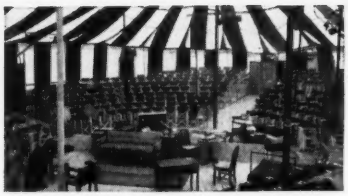
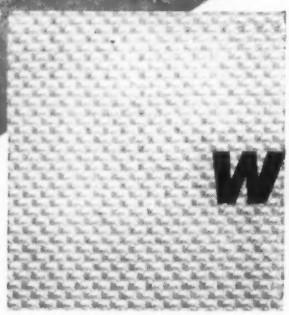


Coater: H. M. Sawyer & Son Co., Watertown, Mass. Fabricator: Hoosier Tarpaulin Co. of Indianapolis.

The theater tent shown here is something special. It's the Tucson Winter Playhouse, first multi-colored vinyl coated nylon tent in the U. S. Its red-and-white striped top is made with Welkote, the Wellington Sears nylon base fabric which, when properly coated and fabricated, combines lightness and handling ease with unusually high tear-resistance, strength, resistance to oil, rot and mildew. This rugged filament nylon fabric has become the base fabric specified by coaters for tarpaulins, truck covers, and protective coverings for industrial, agricultural and marine uses. Specifically engineered for vinyl and neoprene coating, it is available on a continuous-supply basis, in three basic weights and a wide range of widths. It is backed by the experience of Wellington Sears, with a deep understanding of the special needs of the coating industry, and over a century of serving the fabric needs of all industries. This experience is yours to rely on and work with in all our fabrics, whether you specify Welkote or any one of an unequalled number of base fabrics available for every coating use at Wellington Sears. For further information on Welkote, write Dept. H4.



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PLASTICIZER

circular file complete?

Check this list of INDONEX Plasticizer Circulars. If you are missing any and would like to complete your file, circle the numbers you need in the coupon and mail. Your request will be given prompt attention.

Circulars contain suggested formulations for the applications described, specifications of INDONEX Plasticizer grades recommended for each application, physical data—original and aged—on the compounds, etc.

Circulars Available INDONEX Plasticizers:

Circ. 4—in Tire Carcass Compounds
Circ. 5—in Footwear and Heel Compounds
Circ. 6—in Camel Back
Circ. 7—in Motor Mount and Bumper Compounds
Circ. 8—in Wire Jacket and Other Extruded Compounds
Circ. 12—in Low Hardness Mechanical Goods
Circ. 14—in Hycar OR-15
Circ. 15—in Natural Rubber-Reclaim Mechanical Goods and Carcass Compounds
Circ. 19—with Various Fillers in Reclaim Stocks
Circ. 21—in Mechanical Goods Compounds for High Temperature Curing
Circ. 22—in Natural Rubber of Various Qualities
Circ. 23—in Tire Curing Bag Compounds
Circ. 24—in Carcass Compounds
Circ. 25—with Various Fillers in Natural Rubber Stocks
Circ. 26—in Heat Resistant Low Compression Set Compounds
Circ. 27—in Hycar Gasket and Packing Compounds
Circ. 28—in Ground Scrap in Low Cost Compounds
Circ. 29—in Extruded Mechanical Goods
Circ. 30—in Butyl Mechanical Goods
Circ. 32—in Hose and Cover Compounds
Circ. 33—in Low Temperature GR-S Compounds
Circ. 34—in Wire & Cable Jacket Compounds
Circ. 35—in Semi-Ebonite Compounds
Circ. 36—with High Styrene Copolymers
Circ. 40—in Polyacrylic Rubbers
Circ. 41—in Neoprene W. Compounds
Circ. 42—in GR-S Camel Back
Circ. 43—in Reclaim Compounds
Circ. 44—in Super-Aging Neoprene Compounds
Circ. 45—in Extruded Butyl Automotive Compounds
Circ. 46—in "Cold Rubber" (LTP GR-S) Compounds
Circ. 47—in High Mooney Neoprene (Type WHV)
Circ. 48—in Oil Resistant GR-S Compounds
Circ. 49—in Hard Rubber Compounds
Circ. 50—in Industrial Tire Compounds
Circ. 51—in Extruded Bumper Compounds
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Technical Bulletin 13—General bulletin on INDONEX Plasticizers and their compatibility with other materials

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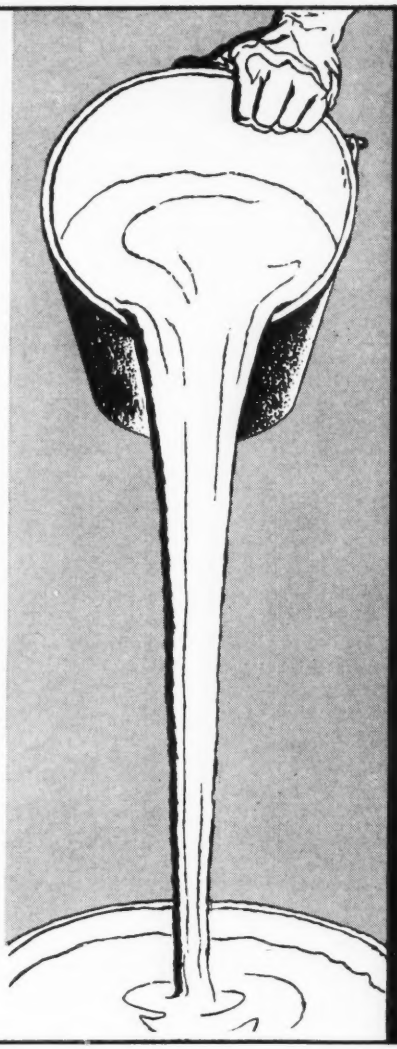

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Modicol VD pours easily, saves you time, guesswork and material waste.

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Advantages of MODICOL VD

Easy to handle
High uniform viscosity at low concentrations
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NOPCO

PLANTS: Harrison, N. J.
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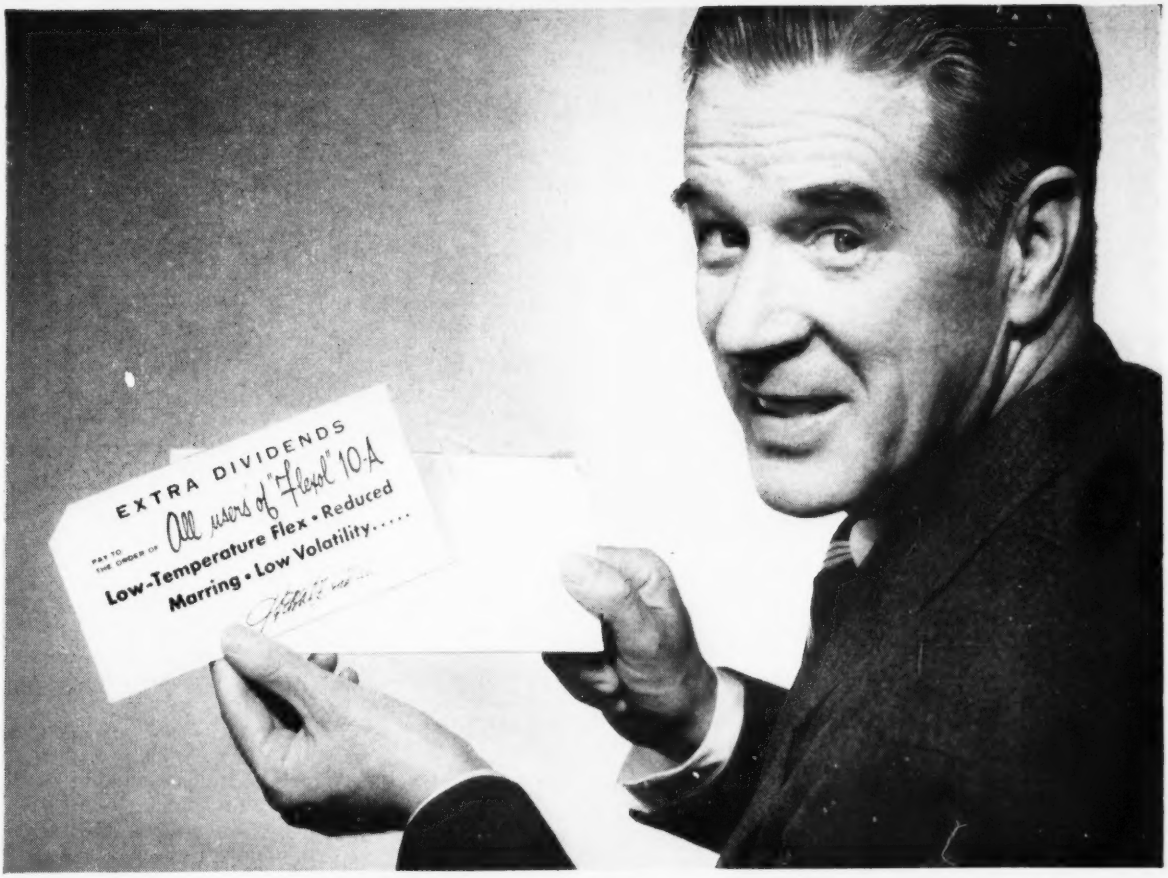

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In addition to superior low-temperature flexibility, FLEXOL Plasticizer 10-A (didecyl adipate) also gives you these extras—low volatility, good resistance to water extraction, and excellent heat and light stability. And FLEXOL 10-A is the best of the low-temperature plasticizers in its comparative freedom from lacquer marring.

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The moderate price of VA-7 is another feature that makes this product worth your investigation. *Try VA-7 for heat-resistant, non-blooming stocks at reasonable cost!*

For compounding information and a sample of VA-7 fill out and mail the handy coupon.

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Outstanding heat aging resistance.
Non-blooming in cured or uncured state.
High strengths at low concentrations.
Easy and uniform dispersion.
Good hot compression set.
Moderate price.

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Please send me compounding information ☐
and a sample of VA-7 ☐

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LONDON

The I.R.I., which was founded in 1921, is now a great association of people engaged in all branches of the Rubber Industry. Its members include rubber producers, manufacturers, scientists, technologists, executives, students and others, in many countries of the world.

It has reached its present position of authority and respect through the high standard it has set for the technical literature it publishes, the diplomas it awards, and the meetings and conferences it organizes.

In collaboration with other Societies, it aims to raise the standing of the Industry throughout the world by improving the technical qualifications of its personnel, extending the study of its raw materials, processes. and products, and by promoting the exchange of technical discovery and information by means of literature, conferences, and meetings.

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Hose & Belting	Upholstery Fabrics
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Rug Underlay	Combined Fabrics
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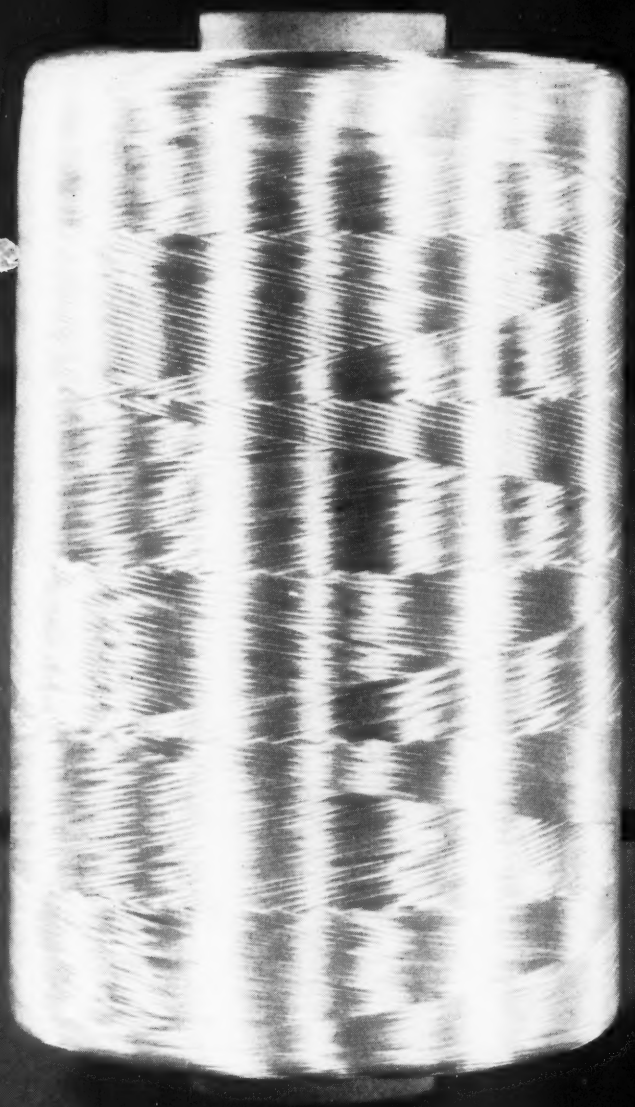

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NYLON HEAVY YARNS

Allied Chemical's new Caprolan heavy yarns are of particular interest to makers of:

Heavy Duck • Industrial Slings • Fire Hose • Cords & Braids
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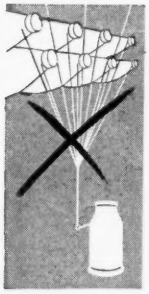
exclusively by Allied Chemical... Caprolan*!

Nylon Heavy Yarns

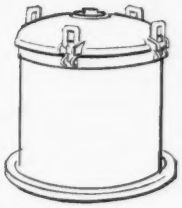
A Completely New Class of Durable Textile Yarns Available in 2,100, 2,500, 5,000 and 15,000 Denier

Mills report these advantages:



1. Cuts Plying Costs! Supplied in the total deniers you need, Caprolan nylon heavy yarns are engineered to your specifications without plies. No need to inventory costly finer deniers. Heavy yarns with nominal twist are supplied on knotless 10-pound parallel nonreturnable tubes.

2. Cuts Heat-Setting Cycles! Another money-saving advantage of these heavy yarns is that heat-setting cycles can be materially shortened because of Caprolan's workability with heat.



3. Minimizes Dyeing Problems! Heavy nylon constructions are much easier to dye when Caprolan heavy yarns are used. Allied's new fiber has a remarkable affinity for all classes of dyestuffs.

Other Heavy Yarns Can Be Engineered to Your Specifications In a Range from 2,000 to 50,000 Denier!

Now, from Allied Chemical—an important new tool for the textile industry—nylon heavy yarns engineered to your specifications! This completely new class of durable textile yarns eliminates need to ply multiple ends of finer deniers to achieve a higher total effect.

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These nylon heavy yarns are made exclusively by Allied Chemical. In addition to all of the known qualities of nylon, Caprolan heavy yarns offer such plus values as affinity for all classes of dyestuffs, *deep* dyeing and uniform level shades.

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Try it in shoe-soling, athletic goods, luggage and other nuclear applications. Obtain samples and literature from Harwick Standard Chemical Company, Akron, Boston, Trenton, Chicago, Albertville (Ala.).

THE GENERAL TIRE & RUBBER COMPANY
Chemical Division, Akron, Ohio

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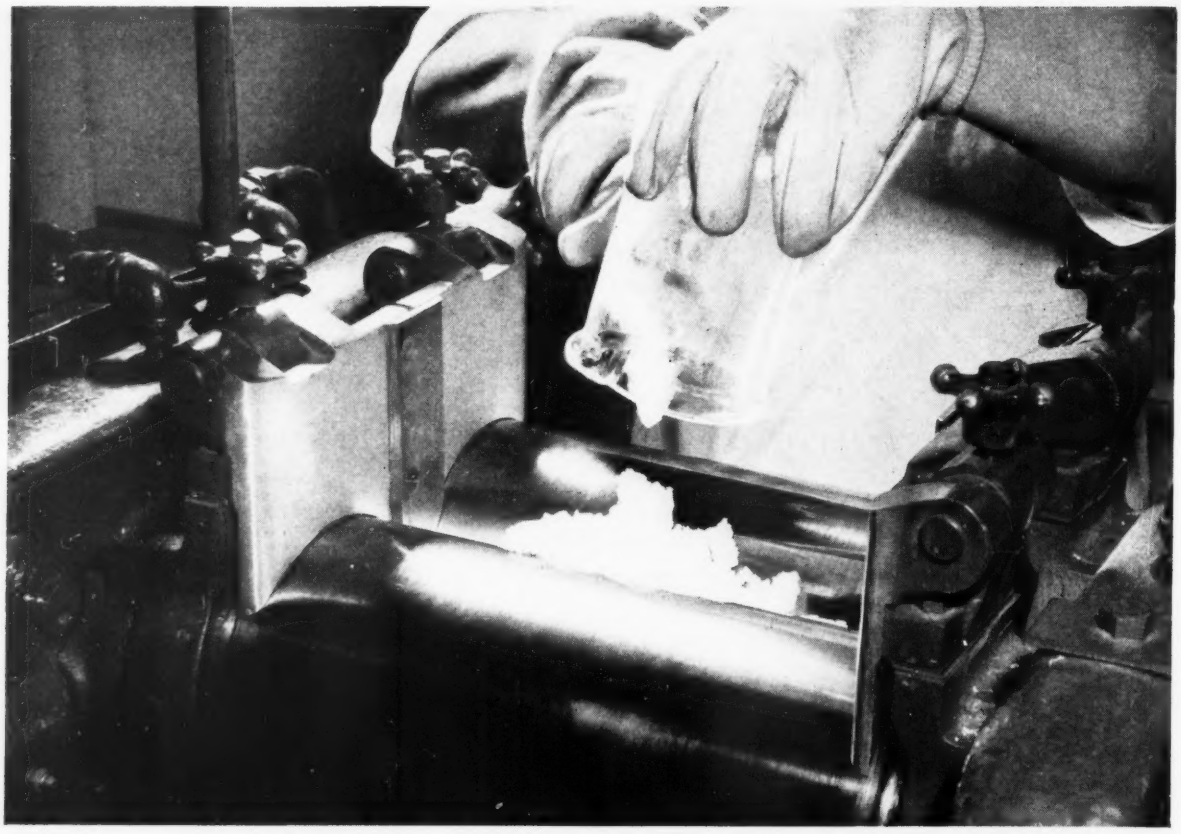

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IN 50 SECONDS WITH...

HARFLEX® 300

Tests show that this efficient polymeric will plasticize PVC resins in 45 to 50 seconds. No secondary plasticizers are needed to produce plastics which are permanent, non-migratory, and have excellent low-temperature properties. Harflex® 300 is the first easy processing, polymeric plasticizer to become available for vinyl resins.

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At your request, a free booklet will be sent to you giving complete information about Harflex® 300. Samples of Harchem's other plasticizers (Sebacates, Phthalates, Adipates) are also available. Write to us giving your requirements for experimental or test work.

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DIXIE 35

Dixie 35 (GPF), general purpose furnace, is a remarkably versatile black with properties streamlined in keeping with today's demands.

Dixie 35 was purposely developed to provide the easy mixing, fast processing, and increased reinforcement normally derived from the use of more than one type black.

Dixie 35 has also other desirable features, such as high resiliency, low heat build-up, good flex resistance, and of course exceptional uniformity.

United blacks are quality blacks commanding confidence everywhere because they do such an excellent job.

For product recognition, specify United. You stand to gain so much.

UNITED CARBON COMPANY, INC.

CHARLESTON 27, WEST VIRGINIA

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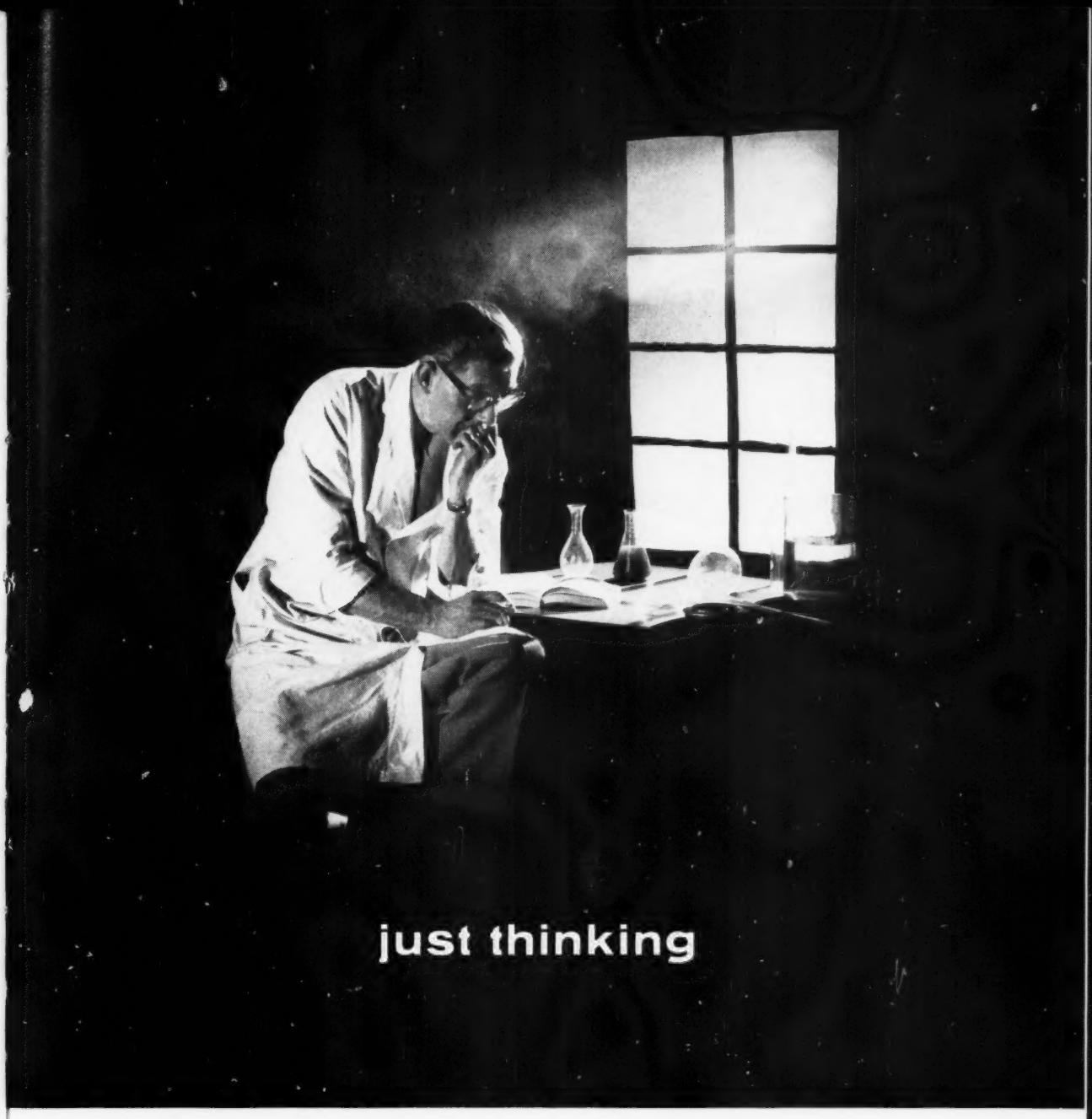

Chemical progress is autoclaves, test tubes, distillation towers . . . hydrocarbons, heterocyclic compounds . . . processes, polymerizations, products.

But mostly, chemical progress is thinking . . . *men* thinking. Little men, big men, medium size men . . . in lab coats, business suits, overalls . . . all of them, always, thinking.

Thinking up new products . . . new ways to make chemicals and new ways to use them. Thinking up more comfort, more convenience, better health, for everyone.

Always, the old things have to be improved, and the new things have to be proved. It takes more thinking. The thinking never stops. And so chemical progress never stops.

It's that way at Koppers.

• • •

Koppers Company, Inc., Chemical Division, Pittsburgh 19, Pa., producers of styrene, Dylex styrene butadiene latices, dbpc® antioxidant, resorcinol, potassium cyanide solution, phthalic anhydride, and many other chemicals.*

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Chemical Progress Week, April 23-28

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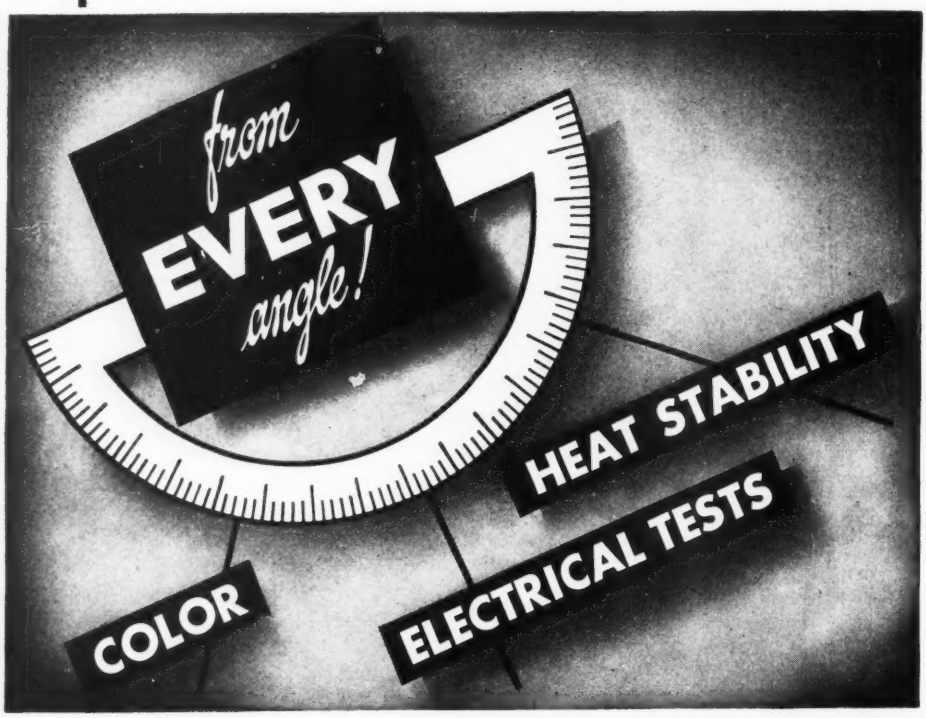

PIGMENT NO. 33

for Compounding

VINYLS AND SYNTHETIC RUBBER

Sample and technical data sent promptly on request

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INVITES CAREFUL APPRAISAL OF

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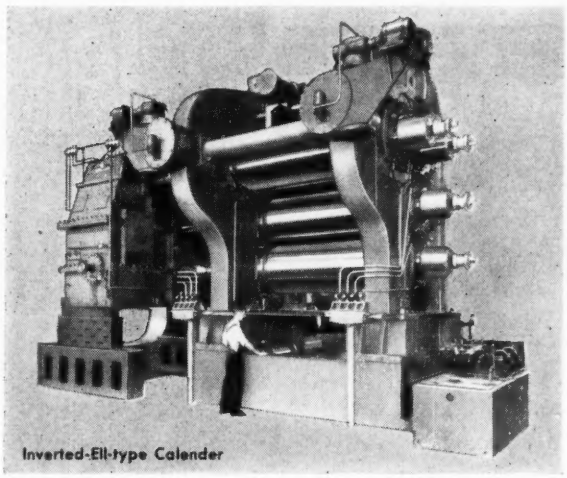
NEW IN CONCEPT—YET CAREFULLY TESTED IN 4 YEARS OF SUCCESSFUL OPERATION

Uniform gauge of calendered stock depends on roll profile or crown. Changes in gauge or width of stock, changes in stock formulation, or minor temperature variations in mixing or calendering processes affect gauge, thus necessitating changes in roll profile.

WITH UNINTERRUPTED PRODUCTION
ROLL PROFILES CHANGED—QUICKLY, ACCURATELY

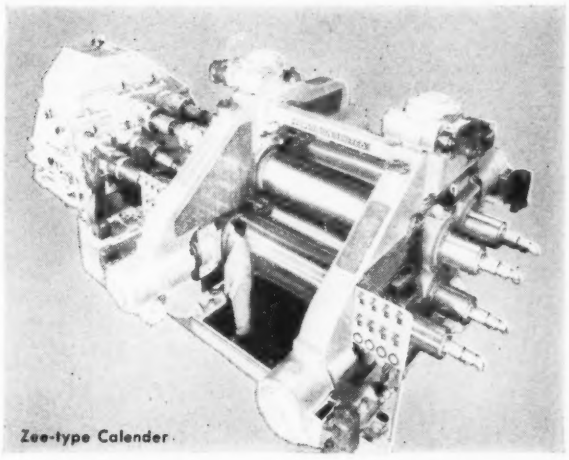


Inverted-Ell-type Calender

Crossed axis is useful in changing roll profile, but for extremely accurate and uniform gauge, the usefulness of crossed axis is limited. With the patented, hydraulically-operated, and controlled ROLL BENDING UNIT, limitations of roll crossing are greatly reduced. In many calendering operations, ROLL BENDING eliminates the need for crossed axis and the accompanying expensive pinion-stand drive.

Users of roll benders in the United States and Canada report results exceeding best expectations. New calenders are now under construction for delivery this year, equipped with roll benders on one or more rolls.

ADAMSON offers the ROLL BENDING UNIT as standard equipment on ALL TYPES OF NEW RUBBER AND PLASTICS CALENDERS —also available for existing calenders.



Zee-type Calender

FOR COMPLETE INFORMATION—CONSULT ADAMSON ENGINEERS

ROLL BENDING REDUCES MAXIMUM WORKING STRESSES IN ROLLS—DOES NOT SHORTEN JOURNAL BEARING LIFE—ORIGINAL ROLL CROWN MAY BE INCREASED OR DECREASED AS REQUIRED

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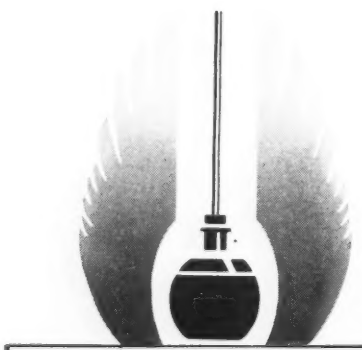
IN ACTUAL USE

STABILITE WHITE

NON-STAINING NON-DISCOLORING ANTIOXIDANT

Since its introduction to rubber compounders, Stabilite White has proven itself again and again in actual use. Users report that this mobile liquid* Non-Staining, Non-Discoloring Antioxidant possesses maximum age-resisting properties, is easy to handle, has sun-light and flex-cracking resistance, and the ultimate in non-staining characteristics. Our customers also report that these properties are obtained at NO INCREASE in compounding costs. YOUR recipes — whether for crude rubber, natural or synthetic — can profitably be converted to include STABILITE WHITE . . . the PROVEN non-staining antioxidant.

*ALSO AVAILABLE IN POWDER FORM



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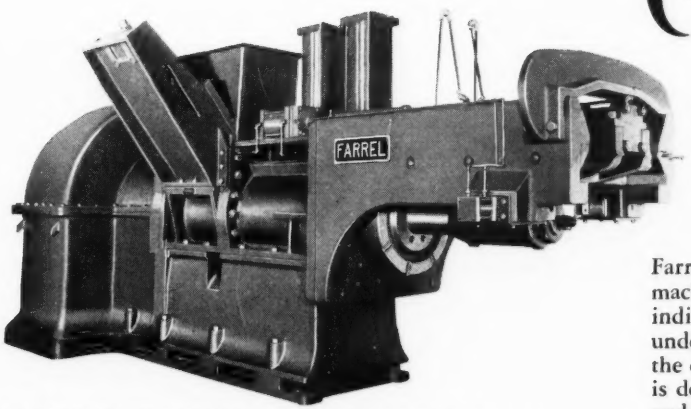
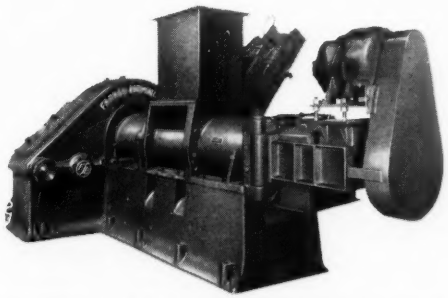
PRODUCTION EFFICIENCY FORMULA:

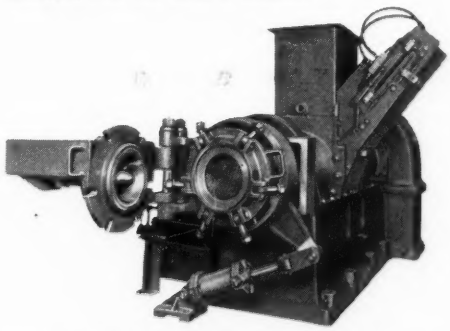
BANBURY® MIXER + MATCHED { EXTRUDER, PELLETIZER, STRAINER-EXTRUDER



15" HEAVY-DUTY EXTRUDER for use with size 11 Banbury on short-cycle operation. Can also be used with two size 11's for longer cycles. Stock is delivered in a 48" wide continuous sheet.



12" PELLETIZER designed to transform bulky lumps of rubber into small, free-flowing pellets. End-discharge head is hinged to permit thorough cleaning when changing from one stock to another.



12" STRAINER-EXTRUDER has small diameter straining head plate without supporting spider, and hydraulically operated breech-lock closure. The extruding head has an externally supported, adjustable cone die. The combined head can be quickly opened and easily cleaned.

Farrel-Birmingham® screw-type extruding machines are heavy-duty units, built to suit individual needs. Generally, they are located under the Banbury mixer for gravity feed of the discharge. The selection of extruder size is dependent upon the size of the Banbury and the duration of the mixing cycle.

These extruders provide continuity of production. Operation is continuous, and the machine generally requires no operator.

The various features of the extruders are dictated by the use intended for them, and the particular requirements of the application. Screw diameters range up to 24".

Whatever your needs may be for heavy-duty extruding machines, Farrel-Birmingham has the experience and engineering ability to produce units that will provide a satisfactory answer to your problems. Write for information about extruders for specific applications or ask for a copy of Bulletin 195.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
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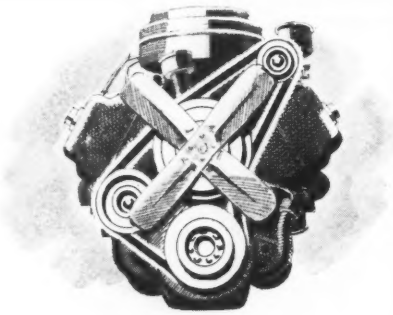
Banbury Mixers • Plasticators • Pelletizers • Extruders • Calenders • Mixing, Grinding, Warming and Sheeting Mills • Refiners • Crackers • Washers • Hose Machines • Bale Cutters • Hydraulic Presses and Other Equipment for Processing Rubber and Plastic Materials

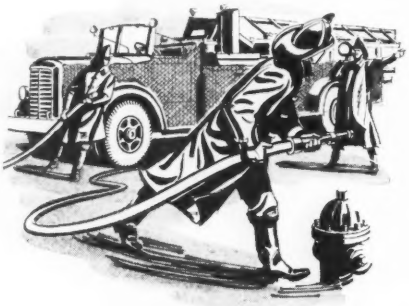
Farrel-Birmingham®

FB-1028

FORTISAN* 36 RAYON FIBER
makes these products STRONGER



V-BELTS. These vital power transmitters gain extra life when reinforced with Celanese FORTISAN-36. After extra long wear stretch is negligible. It won't expand or contract under normal V-Belt operating conditions so as to affect the belt's efficiency. This is because it's dimensionally stable. FORTISAN-36 is far stronger than conventional fibers, imparts higher tensile strength. That's why V-belts with FORTISAN-36 are now being used as original equipment on automatic washers, power mowers, trucks, passenger cars and farm tractors.



HIGH-PRESSURE FIRE HOSE. Used as filler cord in interior and exterior jackets of high-pressure fire hose, FORTISAN-36 pays off in a lighter but stronger hose that's more flexible, easier to handle and rack, and more heat-resistant. Also, it saves space because it folds tighter. FORTISAN-36 saves money in processing since it need not be heat-stretched.

HIGH-PRESSURE HOSE. High tensile strength, remarkable stretch-resistance and nearly perfect dimensional stability make FORTISAN-36 first choice for many types of high pressure hose. It produces a hose that's lighter, safer, more flexible and capable of taking extreme pressures easily. Hose of FORTISAN-36 appear likely to do a better job in aircraft controls, hydraulic presses, power feeds, trucks, greasing tools, road-building equipment.

FORTISAN-36 IS GOING PLACES! Besides these applications, this new Celanese high-tenacity, heavy-duty rayon of saponified acetate has practical application for truck tires, plastic laminates, filters, paper reinforcement, tarpaulins and webbing. Let us show you how it can improve your product. Write for booklet TD20A to Celanese Corporation of America, Industrial Sales Dept., Textile Division, Charlotte, N. C. Branch offices: 180 Madison Ave., N. Y. 16; Pilgrim Sq. Building, 9 Overwood Rd. at W. Market St., Akron 13, Ohio (Tel.: TE 6-2392). *Reg. U.S. Pat. Off.

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YOUR CONFIDENCE has made possible

big progress in pigments

CALCENE®

HI-SIL®

SILENE®

In recent months, we have been discussing the history and development of reinforcing pigment materials—Calcene, Silene and Hi-Sil. All three have essentially followed a similar pattern much as other chemicals and industrial products—from idea through research examination, production development stages, testing, and finally commercial output.

Intriguing as the last decade has been in pigment development, the story has only begun. Unquestionably, the ability to adapt changes in technology to times and conditions will be more a part of the future than the past.

Whatever success has been achieved is not due to any single factor except possibly enthusiasm. Within the Columbia-Southern organization it has been a cooperative venture shared equally by research, development, production, sales and management units.

Still, such enthusiasm means little without the inestimable help and confidence of our many friends in the industry who have made such great contributions to our performance. The willingness to expend time, effort and money verifying the results of our labors in laboratory and production has been most gratifying. Our pledge here at Columbia-Southern is to maintain and enhance this respect through earnest, honest service.

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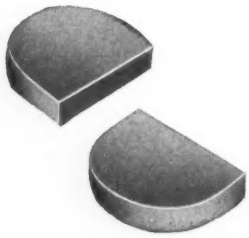
CHEMICAL PROGRESS WEEK—APRIL 23-28

For top lifts that hold their shape under heat and load...

DUREZ *thermosetting resins*



You can get outstanding advantages, both in processing and end-product benefits, with Durez phenolic resins especially designed for compounded stocks or solvent-type adhesives. The familiar top lift of GRS rubber is a typical example.

During processing, resins formulated for GRS serve as effective plasticizers. But these Durez resins have no thermoplasticity after cure and thus serve to prevent both cold flow and distortion under heat. This dimensional stability under load enables top lifts to retain their shape, adding to walking comfort and attractive appearance throughout their service life. And the service life itself is longer because of the resins' resistance to abrasion.

With GRS, Durez resins are effective in small percentages—even as little as 5 to 10 parts of resin on 100 of rubber show results. If you have not looked into the advantage of phenolic resins in GRS, Buna N and other types of synthetic and natural rubber, you may find it highly profitable to talk things over with us. As a starter, let us send you the latest edition of our bulletin on Resins for the Rubber Industry.

DUREZ®

Phenolic Resins that fit the job

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***STAN-TONE MBS - MASTERBATCH**
Colors plastic dispersed. Standardized in color intensity for precision color matching, cleaner compounding.

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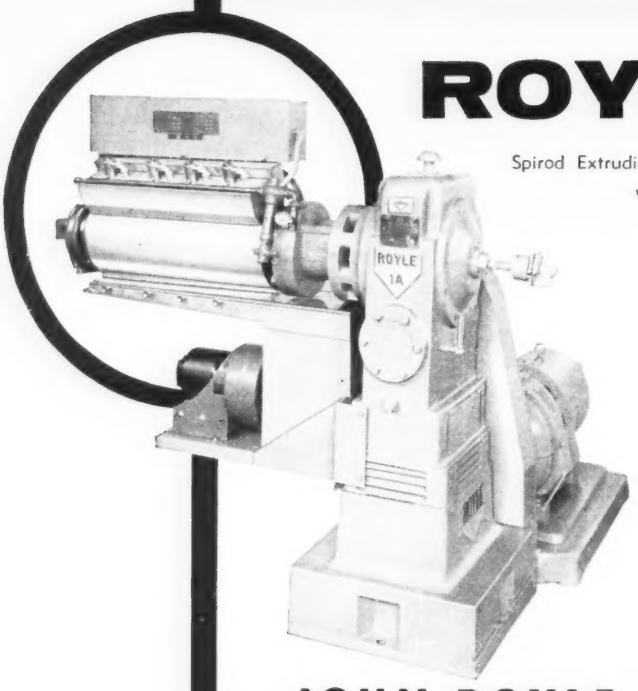

Spirod Extruding Machine with electric heating and high velocity evaporative cooling. An all-purpose extruding machine for processing rubber and plastics. Available in sizes 1⅛" through 12" cylinder bore.

Strainers, Cooling Troughs, Light Wire and Cable Capstans, Motorized Take-ups, Temperature Control Units.

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Philprene®

TECHNICAL NEWS ITEM NO. 3

Replacement of GR-S 1100 with new PHILPRENE 1605 provides improved physical qualities plus superior processability.

The manufacture of mechanical goods requires a rubber with high tensile strength and good aging qualities. In addition, this rubber should also possess easy processability. Up to now, a combination of these qualities was difficult to achieve.

Before the development of PHILPRENE 1605 many compounders were forced to use GR-S 1100, a hot rubber-EPC masterbatch, to meet higher tensile strength requirements. They combined this with a hot rubber-Philblack® A masterbatch when good processability was a must. Now, both of these masterbatches can be replaced by PHILPRENE 1605, a new cold rubber-Philblack A masterbatch.

Before aging, PHILPRENE 1605 is *equal* to GR-S 1100 in tensile strength. After oven aging for 70 hours at 212 F, it is *superior* to GR-S 1100. See data tables below. PHILPRENE 1605 also possesses lower hysteresis properties. And because PHILPRENE 1605 requires less accelerator, compound costs are reduced.

Helpful Technical Service

For information on the characteristics and performance of various compounds, or for advice on processing and recipes, consult your Phillips technical representative. Phillips research facilities and years of practical experience with rubber can be of help in solving your rubber problems. Feel free to call your Phillips technical representative at any time. He will be glad to be of assistance.

	PHILPRENE 1605	GR-S 1100
Mooney ML-4-212 F	40	42
300% Modulus, psi	1600	1150
Tensile Strength, psi	2600	2680
Elongation, %	520	565
Shore Hardness	66	65
	OVEN AGED 70 HRS. AT 212 F	
Tensile Strength, psi	2500	2240
Elongation, %	280	305
Shore Hardness	74	73
Heat Build-Up, T°F	60.5	65.5
Rebound, %	53	44
Compression Set, %	15.6	19.9

Compounding Recipes

Philprene 1605	150	—
GR-S 1100	—	150
Zinc Oxide	5	5
Stearic Acid	2	2
Philrich® 5	10	10
Sulfur	1.75	1.75
Primary Accelerator	1.3	1.3
Secondary Accelerator	—	0.3

PHILLIPS CHEMICAL COMPANY
Rubber Chemicals Division
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is a product of the West, too!

When you need rubber for sheeting, molded or extruded goods, tires or other uses—Shell Chemical is your convenient source West of the Rockies.

The Shell Chemical plant at Torrance, California, is one of the nation's best-equipped for the production of butadiene-styrene types of rubber. Convenient location and diversity of product make Shell Chemical your *logical* source in the West.

When you encounter troublesome technical problems—remember that the Shell Technical Service Laboratory will help you find practical solutions.

Next time you need synthetic rubber—write or call *Torrance, California.*

SHELL CHEMICAL CORPORATION
Synthetic Rubber Sales Division
P. O. Box 216, Torrance, California

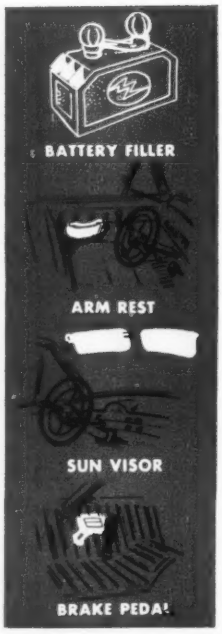
SHELL

Plastisol

These illustrations may spark a new sales development or product improvement for you.

Toughness, chemical resistance, wear resistance, tear strength and flexibility make these compounds outstanding as noise deadeners, wire coatings, flexible molded parts, textile coatings, sealing compounds, glove coatings and in many other applications.

If your product requires a soft plastic coating or a molded part you should consider the use of vinyl plastisols.



"Best Known Name In Plastisol"

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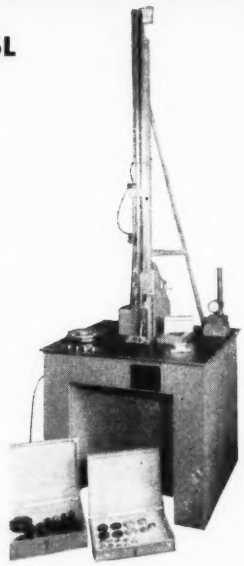
When EXACT determination of modulus is essential.....

Scott Model SL

STRAIN TESTER

especially useful in production control of PRECISION RUBBER PARTS requiring exact dimensions and modulus.



Here is a Scott Tester* that gives exact determination of % elongation at a given stress (modulus) and is operable by non-technical personnel. The Strain Test method—now also adopted in England—gained prominence during development of the Synthetic Rubber Program, when National Bureau of Standards** engineers noted that greater precision was urgently needed in measuring modulus. Scott Engineers participated in developing a satisfactory tester, and the Scott SL is an improved model now commercially available. Its features assure positive accuracy in the ranges of 50, 100, 200 and 400 lbs./sq./in:

- Weight is in free condition—positive accuracy free of friction or inertia interference.
- Precisely uniform width of specimen assured by special easily applied preparatory device.
- Positive compensation for specimen thickness accomplished semi-automatically by simply turning numbered dials to correspond with actual thickness determined by comparator.
- Full-load weighting and timing automatically controlled.
- Time of observation mechanically restricted so any possible residual specimen creep is negated and precise reading is obtained.
- Reading is direct in % of elongation for selected lbs./sq./in. weighting.

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**Mention of NBS does not constitute endorsement by them.

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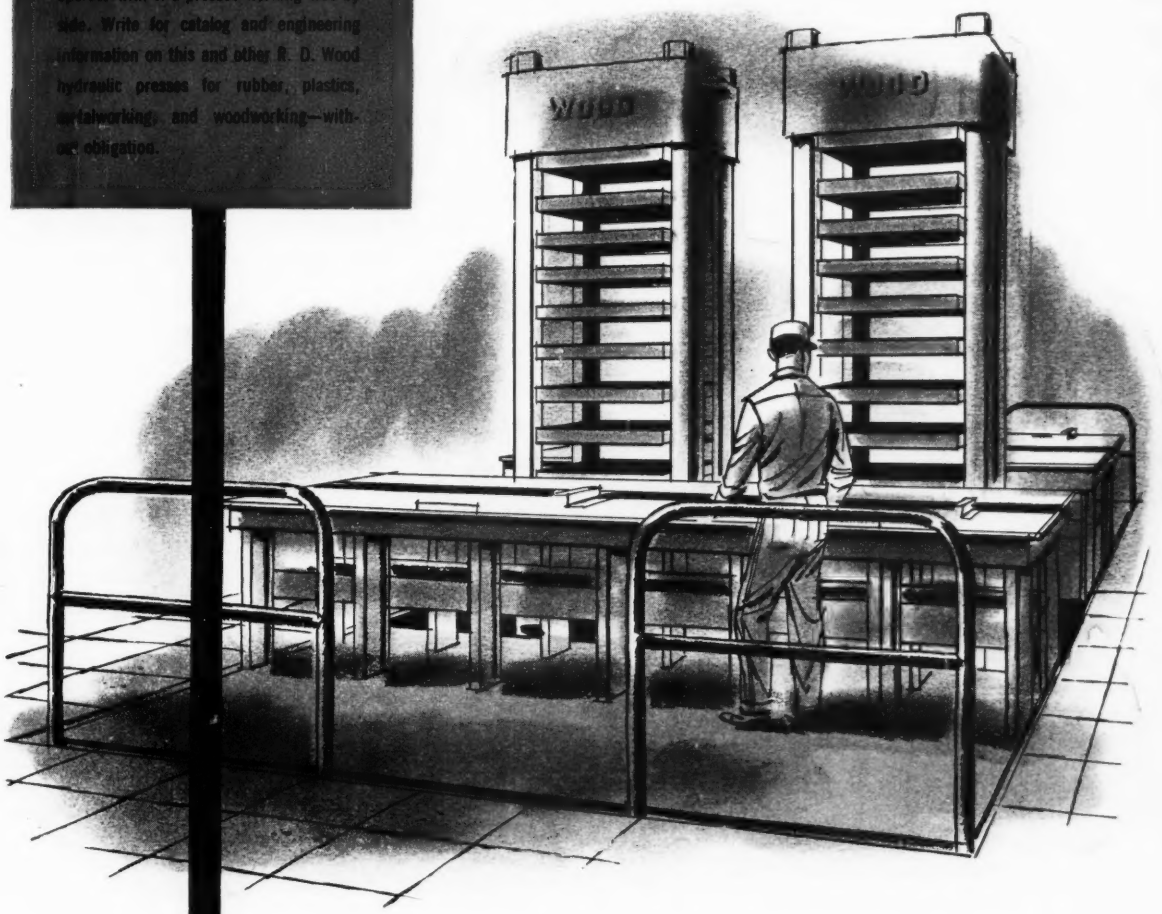
90 Blackstone St., Providence, R. I.

192-ton Multiple Opening Platen Press. Designed for molding rubber products. This press may be operated from an individual self-contained pumping unit or a central accumulator system. Two elevators operate with two presses working side by side. Write for catalog and engineering information on this and other R. D. Wood hydraulic presses for rubber, plastics, metalworking, and woodworking—without obligation.

The nameplate is your guarantee of value

When you buy an R. D. Wood press, you can take *full value* for granted. In more than 150 years, the R. D. Wood nameplate has never appeared on a product of inferior quality. It is your guarantee of sound design, premium materials, superlative craftsmanship. It is your assurance also of smooth, trouble-free performance, high productivity, long life and production economies.



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RUBBER WORLD

APRIL, 1956

VOLUME 134, NUMBER 1

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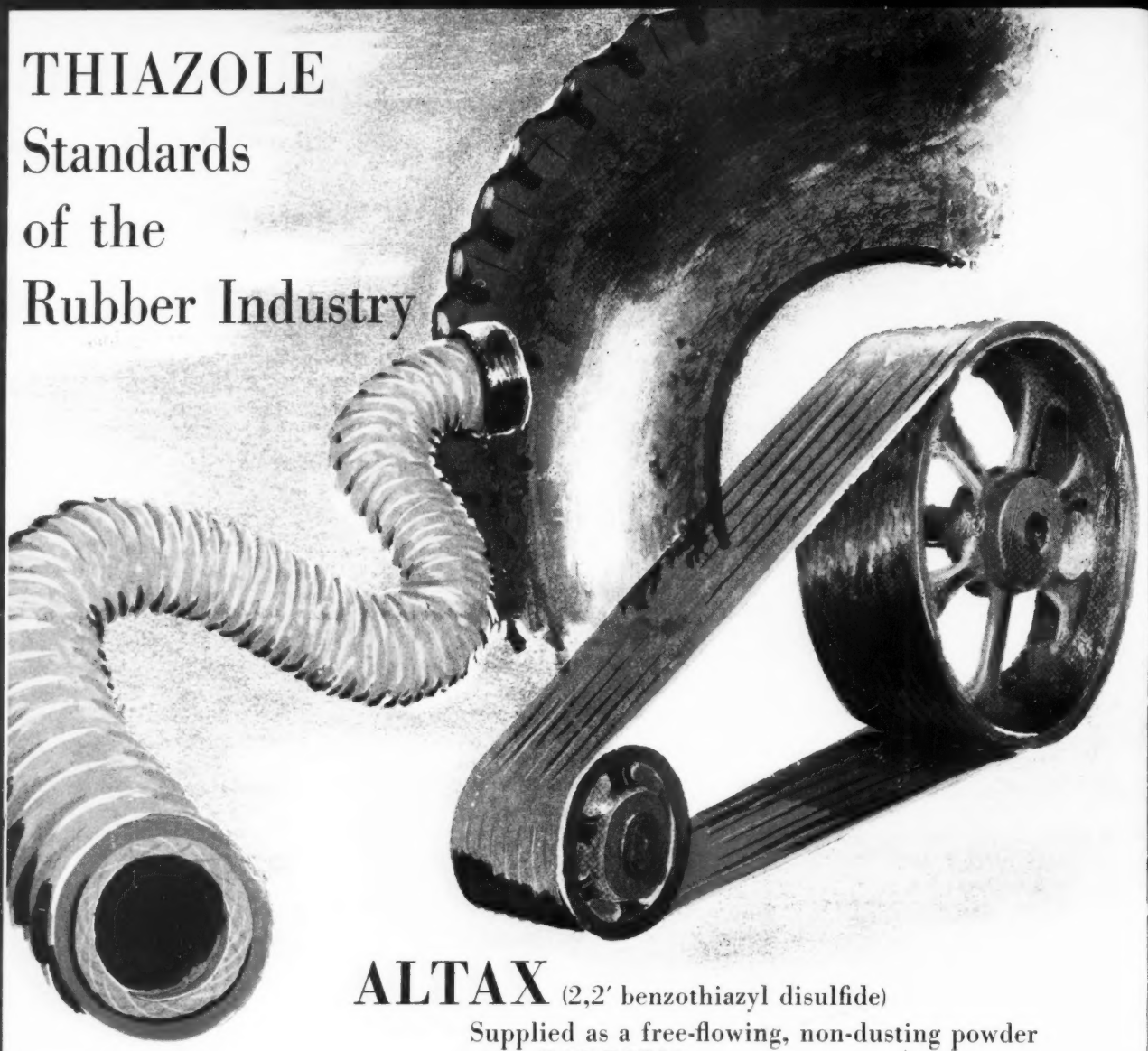
Cover photo, courtesy of The Goodyear Tire & Rubber Co.

published monthly by
BILL BROTHERS PUBLISHING CORPORATION

editorial and executive offices
386 Fourth Avenue, New York 16, N. Y.
Chicago office
333 North Michigan Avenue
Midwest office
244 Water Street, Akron 8, O.

THIAZOLE Standards of the Rubber Industry



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RUBBER WORLD

APRIL, 1956

Ray P. Dinsmore

Specifications for a Rubber Chemist[1]

By RAY P. DINSMORE,
The Goodyear Tire & Rubber Co., Akron, O.

This 1955 Goodyear Medal Award address of Dr. Dinsmore provides a detailed description of the depth and the breadth of knowledge required of the rubber chemist or rubber scientist of today who could be considered as fully experienced in all branches of rubber science.

Although it would seem that no one man could claim such knowledge, it is mentioned that there are numerous rubber chemists who must be familiar with a large portion of this great field of technology in order to carry on their jobs competently.

The rubber chemist serves a large and vital segment of American industry and is engaged in a profession which can be pursued with pride and intellectual satisfaction. His profession is one which calls for the very best effort of the very best men available.

Dr. Dinsmore has taken the opportunity in this paper, therefore, to salute the rubber chemist—an important figure in our industrial society.

TO THOSE of us who have been privileged to witness and participate in the tremendous social and industrial changes which have taken place during the first half of the present century, the question frequently occurs—"What is the cause of this impressive advance which exceeds the combined progress of many previous centuries?" By many thoughtful people it is believed that the chief causes are revolutionary improvements in communications and transportation.

The philosophical corollaries are numerous. No nation has been able completely to compound altered conditions into a balanced political, social, and moral order. Unfortunately the benefits of fast communication and transportation have been available even to the most immoral, ruthless, and brutal political states. This country, which has pioneered in the production of material benefits, has now a strong moral obligation to set an example to the rest of the world in their proper utilization for a strong and free society.

The belief that successful management of the present and future industrial society depends to an important degree upon the advice and services of responsible and competent engineers and scientists, of which there is an existent and prospective shortage, has prompted these observations. If further justification for their pertinence to the subject is required, it may be said that the rubber chemist serves a large and vital segment of our industry.

The debt owed by the speaker to his profession and to this Division of Rubber Chemistry of the American Chemical Society, has encouraged him to devote this medal address to a delineation of the complexity of the rubber chemist's functions and the importance and dignity of his service to society.

When your speaker entered the rubber industry, the rubber consumption in this country for that year was 62,500 tons; this year it is expected to be 1,400,000 tons or more. Although the automobile industry was beginning to show signs of that lusty growth which was to

[1] Presented before the Division of Rubber Chemistry, ACS, Philadelphia, Pa., Nov. 3, 1955.

make it the greatest factor in economic recovery after World War I, rubber was yet to find recognition as one of the essential basic commodities of our modern civilization. Twenty-eight years later it was to become one of the most widely discussed of the critical materials of World War II.

Be reassured that one need not listen to an historical outline of rubber chemistry or a detailed technical description of its component parts, in order to visualize its complexity. A broad view of its major branches, however, is important to our conception of size and composition of the field.

Forty years ago most of the work of the rubber laboratory was devoted to compound tests, raw materials control, and the analysis of finished products. (See Figure 1.) Rubber research was concentrated on the discovery of new organic accelerators. A rare worker here and there devoted his time to the study of rubber structure or the mechanism of vulcanization. Therefore in that period it took but a few minutes to walk through a rubber laboratory and to learn about the activity of its workers. In contrast to this situation, today we must take a long, varied tour. Since time is limited, let us begin.

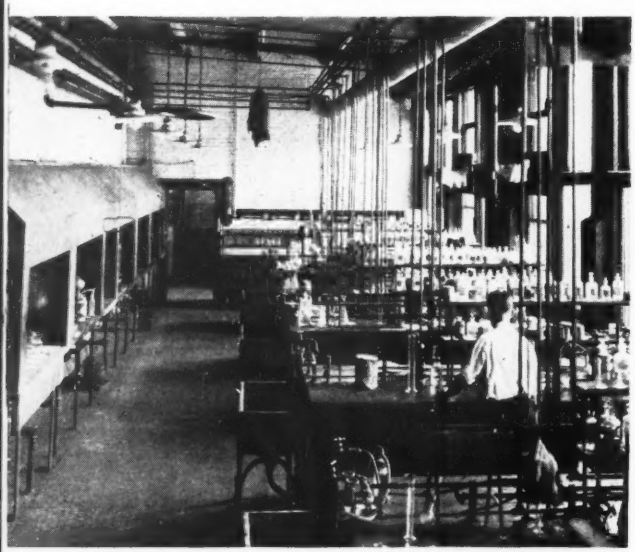

Fig. 1. A rubber-raw materials control laboratory of about 40 years ago. The major activity in this laboratory in those days was the analysis of pigments and other compounding ingredients against specifications for their use in rubber

Our guide is an imaginary character by the name of Dr. Elastomer who is experienced in all branches of rubber chemistry. He will take us through his laboratories, explaining as he goes. My own contribution will be limited to questions and comparisons with the "good old days" of 40 years ago.

Latex Laboratory

Striding ahead, our host first takes us to the latex laboratory. Since he will do most of the talking, we will let him take over with but infrequent quotation credits.

Up to 1920 very little latex was used in commerce. Until then a latex laboratory was devoted mostly to experiments on proofing. Even today we must go to the plantations to carry out our studies of the properties of fresh natural latex which are different in many ways from the preserved variety. There the chemist works with the plant physiologist who seeks to increase yield and to combat leaf and other diseases. When we deal with synthetic latex, however, we may go to a nearby synthetic plant or make it in our laboratory.

Here you will notice physical-colloid chemists studying the properties of latex preserved in various ways. These chemists are observing change in viscosity, vulcanization rate, protein changes, stability, etc. They shake their heads to the question as to whether any improvement on ammonia has been found for the preservation of natural latex. Work on the synthesis and special modifications of latex will be found in the synthetic rubber laboratories.

Other members of this first group are studying the methods and rates of coagulation by electrical, chemical, or bacterial action. The latex particles themselves are under microscopic examination to note variations in Brownian movement, particle shape and size and the alteration in the surface layer caused by stabilizers or agents for changing viscosity. (Most of these studies dated back to my early research days and thus gave me the assurance of familiarity.)

In another group you may see work on various methods of latex concentration in order to provide high-solids latex for making rubber foam. In its infancy 25 years ago, rubber foam is now one of the industry's fastest-growing products. Creaming, by the aid of various agents, centrifuging, evaporation, electrodecantation, and filtration, is in evidence.

Synthetic latices are being given special treatment to compensate for their smaller particle sizes.

Vulcanization in the liquid state was one of the wonders of the middle Twenties. Its achievement after or while drying is being examined by varying not only the suspended curatives, but also the whole colloidal system.

On a miniature scale is carried out coagulation to be followed by washing and drying, compounding, milling, vulcanizing, and testing in a special physical testing laboratory.

While this series of explanations had been going on, I was examining the varied kinds of apparatus that were in use, and as we left the latex researchers, I said to Dr. Elastomer,

"This equipment is mostly for physicists. How is the rubber chemist involved?"

He gave me a condescending smile and replied, "The rubber chemist must understand these methods and the significance of the results in order to do an intelligent research job or specifying the production application and required improvements for latex of all types. After all, the latex is the foundation of all our rubber work. We must know all about the individual particles, how to protect them, modify them, agglomerate, coagulate, vulcanize—all these things so we can either use latex in that form or make good rubber from it."

Synthetic Rubber Laboratory

He then conducted me into the synthetic rubber laboratories.

When we talk about synthetic rubber in these laboratories, we mean the general-purpose type of butadiene-styrene copolymer, which was called GR-S by the government in the war period. The numerous other special synthetics are accorded a much more limited treatment for reasons to be mentioned later. We have a special and somewhat sentimental interest in GR-S. It not only represents a great industrial achievement to which the rubber chemists made vital contributions, but it constitutes the first nation-wide recognition of the importance of rubber and the services of the rubber chemist.

Now that many rubber goods manufacturers make their own rubber, the experience of the chemist must start with the raw materials for his rubber and carry through to the final rubber products.

"This," I reflected, "is making life more complicated."

In these next laboratories you will see special analytical examinations of the monomers, necessary because of the important influence of purity. You will note that some chemists are examining soaps. The quality of these emulsifiers is important to the polymerization process. Other materials are being studied, but fatty acid soaps and sodium resinates are mostly used.

The initiation and modification of polymerization by the reaction of various mercaptans to form free radicals is an important step in the process. It is under constant study, together with the action of mercaptans as regulators of molecular chain length. As a modifier, the mercaptan controls molecular weight and hence viscosity.

The importance of the study of free radicals as initiators is shown by the development of the redox system which first made practical a low-temperature GR-S and is now showing promise for "hot rubber."

Other investigators are adding to their knowledge of oil-extended rubber. Here we have the amazing phenomenon of the swelling of very high molecular weight polymers by a cheap oil, which provides sufficient plasticity to make the rubber processible without entirely offsetting the beneficial strength and toughness of the polymer itself. By this master stroke the physical chemist has combined lower cost with higher quality and larger GR-S plant output. The further addition of carbon black makes additional economies.

This is only one of the benefits to be derived from the study of rubber structure and the inter and intra molecular effects produced by an intimate mixture with other materials.

Logically, this leads to a search for further knowledge of the place where the reaction takes place—the soap micelle, the polymer-monomer particle, the aqueous phase, the dispersed monomer particle. (See Figure 2.) This has given us some insight into the mechanics of polymerization, but less satisfactory comprehension of its kinetics. No mathematical formula has been devised which includes all of the variables. We are still seeking to find that, but we are agreed that polymerization is a free-radical-chain mechanism.

At this point I looked at my host suspiciously. This seemed a "highbrow" diet for an old rubber chemist who in his rookie years worried about the correct interpretation of an analysis of a vulcanized rubber compound or the structural formula for thio carbanilide. He loftily assured me, however, that a rubber chemist could no longer rely upon empirical formulations, as though he were making a concrete mix, but must think in terms of molecular—at times even atomic—structure. However, he led me back to more familiar ground by taking me through the area devoted to methods for determining the properties of the synthetic rubber at various stages of manufacture.

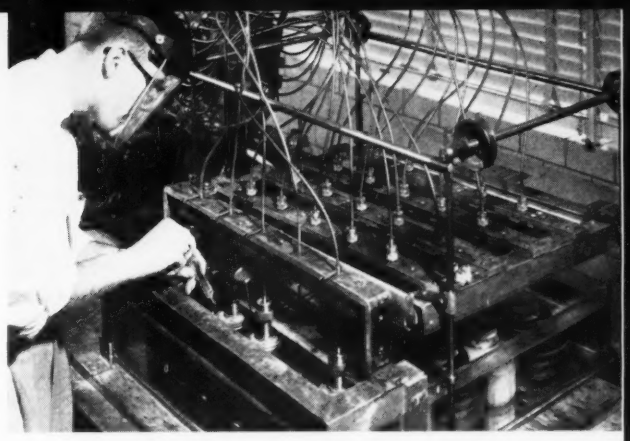

Fig. 2. New type of multiple-unit bottle polymerizer used for small-scale preparations of synthetic rubber or high solids latex. Materials are being added during a high solids latex run in much the same manner as can be done in large-scale equipment

We found technicians, physicists, and chemists studying coagulation, drying, weighing, plasticity, and total solids of in-process latex. Optical observations were also in use. Increase in molecular weight and particle size was under observation by checking solution viscosity, osmotic pressure, and the use of the ultracentrifuge, and various optical methods. The properties of high and low molecular weight fractions were being determined. Solubility, processing, and physical strength are affected.

Fig. 3. Apparatus for preparation of catalyst for making synthetic polyisoprene or synthetic natural rubber. The high flammability of the ingredients necessitates handling them in a completely inert and dry atmosphere

As we approached another group of physicists, Dr. Elastomer remarked, "These men work with many kinds of polymers."

They are specialists on polymer structure, and, as a matter of fact, they usually work on other than GR-S type polymers. One of their important investigations has to do with crystallization effects which are normally observed in rather highly purified polymers by the use of X-ray defraction at normal and at low temperatures, and by dilatometric volume measurements. They study second-order transition effects, *cis-trans* isomerism, and the effects of mechanical or chemical degradation.

Since it is important to know how much deviation there may be from straight chain structures and how much cross-linking exists between chains, a portion of the laboratory carries on work on the determination of sol and gel fractions, gel swelling index, concentrated solution viscosity, infrared spectrometer readings, and the relation between viscosity and molecular weight.

It is important to know the ratio of butadiene to styrene in the finished copolymer, as compared to the initial charging ratio under various circumstances of temperature and conversion. This point also applies to other polymers and copolymers.

This other group of chemists is engaged in determining the effect of various polymerization conditions on saturation, ozonization, oxidation, and hydrogenation. They likewise are studying 1,2 and 1,4 addition in the chain structure, as well as *cis* and *trans* isomerism by chemical means. They are compiling important information on the existence and location of internal and external double bonds by ozonolysis, perbenzoic acid, and the use of infrared.

With respect to specialty rubbers, it is necessary to have the same detailed information with regard to structure and the effect of process variables that is required for GR-S type rubbers. In ordinary laboratories the research people consider the problems only of those rubbers which are made by their individual companies, with perhaps the addition of one or two new rubbers not yet in production.

In this laboratory, however, every kind of rubber chemistry is being applied to every known type of rubber, and we, therefore, walked through a series of large laboratories, one of which was devoted to the study of neoprene, one to butadiene-acrylonitrile copolymers, and others to butyl, acrylic elastomers, silicones, thiorubbers, polyesters, and polyurethanes. In addition, a large group of chemists and physicists was busily engaged in the synthetic duplication of natural free rubber. (See Figure 3.) These workers showed particular satisfaction and consciousness of achievement.

Compounding Laboratories

With this startling and confusing demonstration of the available varieties of synthetic rubber, I turned with anxiety to that section of the laboratories dealing with studies of vulcanization and compounding, and it seemed to me that the complexities introduced by the use of so many types of rubber must be far greater than were involved in the early days with the different wild rubbers which introduced, chiefly, problems in processing and rate of vulcanization.

If one were to consult C. O. Weber's book[2] published in 1902, one would find no reference to organic accelerators, and nothing of the reinforcing effects of fine pigments. Within the next decade, however, zinc oxide and other fine pigments became recognized as useful toughening agents, and aniline was discovered as an accelerator of vulcanization.

As we discussed the progress of accelerator development, it was recalled that those which were developed for application to natural rubber and which were generally applicable to the GR-S types embrace the benzothiazoles, the thiuram sulfides, the salts of dithio acids, the guanidines, and the aldehydeamines.

The early efforts were devoted not only to faster vulcanization, but to improvement of rubber quality, and particularly to the amelioration of cure variation in the cheaper wild rubbers. Later on improved aging effects were given more importance, together with the "long plateau" cure which referred to the ability to produce good vulcanizates over an extended vulcanization time or range of temperatures. This was especially important in the development of pneumatic truck tires. Most recently, in connection with the use of the new highly reinforcing blacks, more and more emphasis has been placed upon freedom from scorch or incipient vulcanization at processing temperatures.

In the use of special rubbers such as neoprene and thiorubbers, special types of accelerators are required. For example, with neoprene, magnesium oxide and zinc oxide are both considered vulcanizing agents, but zinc oxide acts as an accelerator over a wide range of temperatures. For the different types of thiorubbers various vulcanizing agents are used, the most common of which is zinc oxide which may be supplemented by other materials such as p-quinone dioxime.

The polyurethanes are still under intensive study because of their tendency to prevulcanize. They may, however, be vulcanized by additional amounts of diisocyanate, or by other and more conventional vulcanizing agents, depending upon the available active groups.

"It seems strange," mused the Doctor, "that nature provided natural rubber with such a powerful antioxidant that it was unnecessary for rubber chemists to provide artificial help in this direction for many years."

In fact, it was only in the latter part of the 1920's that antioxidants were made and used in substantial commercial volume. For 30 years, however, this has been the subject of constant research, stimulated by the need of providing rubber products which would age well in high temperatures, which could be made, if necessary, in white or light colors without staining, and which would have increased resistance to flex fatigue.

Ordinarily these materials fall into three groups: diarylamines, ketone reaction products, and phenols. The mechanism of their action is still under constant study, but we have evidence that it has to do with interference with the peroxides which are formed or the inactivation of the chain-carrying mechanism. The in-

[2] "The Chemistry of India Rubber." Griffin & Co., London, England.

fluence on flex fatigue is rather obscure and may not be directly connected with antioxidant properties.

Some of these research workers are studying the problem of increased solubility of the antioxidant in the rubbers in order to make possible greater protection without unsightly surface bloom. Others are trying to improve the antioxidant effect of non-staining materials, notoriously less effective in their protective action.

Right adjacent you will see work going on in the field of antiozonants. Ozone attacks rubber very rapidly, even when the ozone is present in the air only in very small quantities. Some of our modern synthetics, particularly those made at low temperatures, are unusually susceptible.

You will find that studies are being made of the effects of waxes that come continuously to the surface in just sufficient quantities to protect it. Also, the chemists are devising new inhibitors, of which p-phenylene diamine is the best example. Possibly by the time they reach the solution of their problems, new rubbers will have been made which are not susceptible to the attack of oxygen and ozone.

The laboratory which you are now looking into, and which has some of the appearance of a drug store, has many types of materials which are investigated for their softening or plasticizing effect on different types of rubber. These materials vary widely as to type. Some are petroleum products, and some are polymers which are made of the same materials as the rubbers or the plastics. Solubility change in rubber plasticity, temperature effects, all are being studied and recorded.

Workers in this laboratory are supplemented also by chemists who are working on chemical plasticizers that make faster or more pronounced changes in rubber plasticity when used in the process of rubber mastication. In general, they act to break the long rubber chains and usually require the presence of oxygen. They should not affect rate of cure, nor should they impart odor or stain, or be toxic. These materials are important chiefly because they increase the capacity of mixing equipment.

Next we see a special group of physicists and microscopists who are studying various materials to determine their value as reinforcing agents. Most of these materials are carbon blacks and inorganic pigments, and they are investigated for their particle size, dispersibility in rubber, adhesion to rubber when it is stretched in the vulcanized state, and their effect on modulus, strength, and tear resistance. The mechanism of their action, although it seems to be roughly proportionate to the fineness of the particle, is not always clear and is still subject to much rather fundamental research.

Now we see a laboratory devoted to the investigation of blowing agents for the production of porous rubber, or porous plastics, usually by the release of nitrogen or carbon dioxide, and you will note that workers are dealing with such varied materials as diazo compounds, nitroso compounds, hydrazides, sodium carbonate, and ammonium carbonate in various mixtures.

Most vulcanized rubbers have their greatest usefulness when the vulcanizing change is interrupted at some point which is considered to be the best cure, or at least within the optimum cure range. Usually the desired result is a product which will age without significant change in its characteristics throughout its expected service life. The criteria for optimum cure are not always easily determined, although the compounder is aided by various accelerated aging tests which will be seen in another laboratory. Some experience with the rubber and the general type of compound is usually necessary for the determination of the best cure.

In addition to this, the determination of the rate of temperature rise in complex shapes and sizes of rubber articles is a matter of importance and some intricacy. Correlation of the rate of temperature change, or the amount of heat added, with the change of vulcanization characteristics is an important one and must be determined for every variety of rubber with whatever vulcanization system is required.

High-Polymer Chemistry

You now enter a laboratory devoted to high polymer chemistry which is engaged in a study of the mechanism of vulcanization as it affects the structure of the rubber. Here you will notice a reference to primary and secondary molecular linkages, the tendency of certain rubbers to form cyclic compounds under some conditions and to cross-link under others, the effect of sulfur and oxygen in natural rubber and GR-S, and the reactive points in such condensation rubbers as the polyurethanes.

It is here also that you will see numerous models which show possible relations between atoms, double bonds, active points for linking to other molecules to form chains, cross-bridging points, etc. The most interesting and perhaps the least accurate are those which are intended to show the forces involved in the elastic properties of rubber.

These scientists have made much progress in recent years, but must at times feel frustrated because of the fact that new and diverse types of rubber are being discovered faster than their theories of vulcanization and rubber structure can keep step.

Organic Chemistry

As we step into the next laboratory which is devoted to the improvement of techniques and apparatus for use by the organic chemists, I am reminded to summarize for your benefit the part that the organic chemist has played in these various projects that we have viewed.

Because he is an expert in organic synthesis, he is needed and, in fact, is the primary worker in the development of accelerators, antioxidants, monomers for making synthetic rubber, rubber adhesives, rubber derivatives, and plasticizers. He likewise takes the information and theories put out by the high-polymer chemists and produces compounds or adds groupings to compounds to produce specific results such as delayed-action acceleration, special types of antioxidants, and other things. He utilizes the structural studies to enable him to synthesize new polymers, and he must apply knowledge of reaction rates with natural rubber, synthetic rubber, and plastics to the protection against oxygen and ozone. He must likewise know the influence of any source of energy, such as that from radioactive

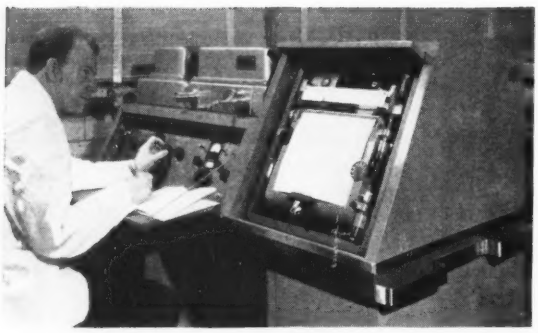

Fig. 4. This infrared spectrograph is used for determining the molecular structure of polymers. In addition, it serves broad purposes in the analysis and identification of polymers and related materials by means of a "fingerprint" system of filing the spectra

materials, and apply that knowledge for the production of more stable rubbers.

The organic chemist must work closely with the physical chemist in determining relations between chemical structure and physical properties, particularly in dealing with molecular weight relations, isomerism, and the reaction of free radicals.

Physics Laboratory

Rubber compounding made much of its best progress in the early Twenties, with the aid of applied physics. Changes in rubber occurring during extension stimulated curiosity. These had to do with changes in density, the Joule effect changes in reactivity toward oxygen and other things. Also the phenomena connected with slow and rapid "freezing" were thought-provoking. In the middle Twenties, however, theoretical physics acquired new importance for rubber with the discovery of crystal structure by X-rays and thermodynamic analysis of the process of stretching.

Today the physicist has a kinetic theory of elasticity which seeks to explain the characteristics of different rubbers, and to account for certain thermodynamic effects of crystallinity in extension and "freezing." To this end he studies changes in specific volume, heat capacity, and compressibility. He determines modulus of elasticity, refractive index, dielectric properties, and the phenomena produced by double refraction and light transmission.

There is practical interest in the study of dynamic hysteresis because it is a direct measure of the heat caused by imperfect elasticity of rubber under alternating stresses. Dynamic hysteresis is also of theoretical interest in the study of the forces existing between the tangled chains which compose rubber.

You will also see the physicist utilizing X-ray diffraction to identify resins, plastics, and rubbers of various kinds; to determine particle size; and to study the crystallites formed upon stretching which affect tensile strength, flex life, and stiffening at low temperatures.

The infrared spectrometrists have a language of their own. By subjecting the polymer to infrared radiations they cause vibration of the constituent atoms and molecular rotations. These are interpreted by reference to known standards to give evidence about polymer structure, the mechanism of polymer formation and changes produced by vulcanization or oxidation. (See Figure 4.)

Next you may note the study of the effects of low temperatures which cause rubber eventually to stiffen and finally change to a hard glassy state. The mechanism is only partly known. First- and second-order transitions are under study, changes in refractive index, dielectric constant, specific volume, stiffness, and brittle point.

Now we come to the ever-intriguing electron microscope with which they are studying pigment reinforcement, particle size, surface area, micromolecular structure, and the various details connected with latex. These studies combine to add to our knowledge of rubber reinforcement strength, modulus, hardness, plasticity, and elasticity. They bring grist to the rubber chemist's mill. (See Figure 5.)

Still further on you may see the investigation of very practical problems by the application of the principles of physics. Here sonographic methods are used for the analysis of tire noise. There one sees tires being tested for blisters or separated spots, by the use of supersonic vibrations. At another point the Instron tester[3] is in use to show various stress-strain and hysteresis effects.

[3] Instron Engineering Corp., Quincy, Mass.

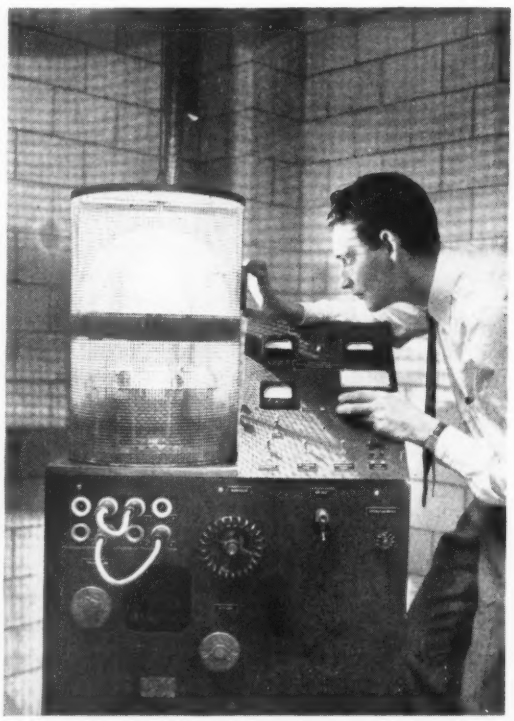

Fig. 5. This apparatus is a vacuum evaporator being used to deposit a thin metal film on an electron microscope specimen. When appropriate angles are used in the examination of the specimens, very fine surface irregularities are revealed their shadows

Physical Testing Laboratory

Let us now move on to the physical testing laboratory. It hasn't much glamor, but requires constant painstaking attention to details, and has frequent addition of new kinds of devices—mostly intended to give better test information. There are various machines for determining tensile and elongation, of which the newest and best is the Instron. (See Figure 6.) Various tear resistance tests are in evidence. Hardness has more limited treatment. Abrasion has many types of testers—none of which satisfies the compounder.

Walking along we see resilience testers—the pendulum and the vibro tester. Then the low-temperature torsion test, flex testers, accelerated aging and weathering testers, adhesion testing, and other less-common physical property determinations.

Special tests are needed in special industries as, for example, the electrical breakdown test for electric cable.

Fabric and Fiber Research

If the physical testing has become more complicated in recent years, this point is still more true of fabric research apparatus applied in the interest of tires, hose, belting, V-belts, airship envelopes, clothing, and footwear. The fibers involved are cotton, rayon, nylon, glass, wire, linen, and the new synthetic fibers. These must be studied as to adhesion to the various rubbers, the optimum stretch, twist and temperature in the various stages of construction and processing. Methods for determining flex fatigue and separation from rubber under dynamic conditions are in constant use.

It is frequently necessary to form the initial fiber in order to study heat and tension effects and that of various sizing materials.

Radiation Physics

Now we shall see the scientific branch which is the latest to supply aid to the rubber chemist, the radiation physicists. By their help the organic chemist has learned the use of tracers for the study of vulcanization reactions, and the solubility and migration of sulfur. (See Figure 7.) Likewise, he has developed the techniques and conditions necessary for determining the radiation stability of rubbers and plastics. This is becoming more important with the development of atomic fission and the use of radioactive isotopes for various commercial purposes.

Fig. 6. The Instron tester is a versatile, electronic machine for the investigation of relations between the physical properties and the chemical structure of polymers

Fig. 7. Apparatus shown here is used in connection with radioactive tracer techniques which give new information on the mechanism of vulcanization and other phases of rubber chemistry

Also a fascinating field of research is involved in the modification of materials by radiation. Among these changes are beneficial cross-linking effects, and rubber can thus be vulcanized to a certain degree.

These radiation physicists are just getting equipped to carry on more extensive work. Their influence will increase greatly in the next few years.

As atomic energy develops more extensively as a power source for airplanes, even such complex structures as tires may be required to withstand severe exposure to radiation.

Similarly, as jet plane speeds increase, tires and other rubber articles may be exposed for varying periods, to temperatures of 800 to 1000° F.

So the rubber chemist is already in sight of new problems, different and perhaps more severe than the former ones. Even his new rubbers and new methods may prove inadequate to reach the solution without further aids. Forty years hence the rubber laboratory may show even greater changes than those we have just observed.

Applied Statistics

In the following rooms were people who seemed to be using no apparatus, but computing devices of various types. I learned that these were experts in experimental statistics. This was indeed a new aid to the rubber chemist, and I eagerly sought for enlightenment as to its uses. Dr. Elastomer explained that in this day of expanding problems and shortage of trained scientists, the statistician might well prove to be of untold value.

(Continued on page 72)

The Reflection Meter for Determining Staining and Discoloration of Rubber Compounds[1]

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A method for quantitatively determining the degree of pigmentation, staining, and discoloration of rubber compounds by measuring the light reflectance of white unexposed and ultra-violet light exposed samples has been investigated.

The decrease in reflectance of the test specimens provides a numerical value for discoloration and staining which is related to actual reflectance ratings. Also, the reflection meter will show differences between white stocks containing no carbon black and those with as little as 0.001% carbon black.

An exposure period of about 24 hours was sufficient to produce determinable amounts of discoloration and staining; while a two-hour exposure period was too short. The reflection meter can be operated by non-technical personnel.

WHITE or light-colored vulcanized stocks of natural or synthetic rubbers have a tendency to stain materials with which they are in contact and to discolor when exposed to light. The degree of staining and discoloration is influenced not only by the length of exposure, but also by the materials contained in the rubber compound.[3]

For many years the problem of reporting information concerning the degree or amount of discoloration, staining, or pigmentation has been limited to a description of the change in color determined by visual inspection. It was difficult to compare the degree of change between samples tested months apart because of the inability to obtain a constant intensity of exposure with time at various periods. Various investigators have used carbon arc[4, 5] or ultra-violet[3, 5, 6, 7] light sources as a means of accelerating the staining and discoloration. In general, the rating of the extent of staining and discoloration has been based on visual inspection[3, 4, 6, 7] and reported qualitatively.

In an investigation of the effect of light on neoprene synthetic rubber, however, Sanders[5] measured the light reflectance changes caused by exposure of the vulcanized slab. The reflectance of light of five different wave lengths, in the visible spectrum of 4000 to 7000 Å, was measured. The light reflectance measurements were made with a Beckman spectrophotometer, using magnesium oxide as the standard, to give a quantitative measurement of the degree of discoloration.

The Government Laboratories investigated the use of the Photovolt[8] reflection meter as a photoelectric means for determining the degree of pigmentation, staining, and discoloration of compounds of synthetic polymers by measuring the light reflectance of unexposed and ultra-violet light exposed portions of test specimens.

The procedure presented in this paper provides a means for the quantitative measurement of the pigmentation, staining, and discoloration of vulcanized stocks.

Equipment Used

The equipment used for measuring the light reflectance was the Photovolt photoelectric reflection meter, Model 610, with a Model 610-Y search unit and a green tristimulus filter. The search unit is constructed so that the light source is directly above the surface of the test specimen, and the photoelectric cells are positioned to receive the light reflected from the surface of the specimen at a 45-degree angle. An external mirror-type galvanometer was used in place of the built-in galvanometer to obtain more accurate readings (Figure 1). The galvanometer scale reads 0 to 100, and it is the readings from the galvanometer scale that are reported as reflectance values. The reflectance of a perfect white would be 100 on the scale. The degree of deviation from perfect whiteness is indicated by the galvanometer scale readings for the materials being tested; the higher the scale readings, the more light is being reflected from the surface.

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[1] The work discussed herein was performed as a part of the research project sponsored by the Federal Facilities Corp., Office of Synthetic Rubber, in connection with the Government Synthetic Rubber Program.

[2] Formerly with the Office of Synthetic Rubber, FFC. Presently at Goodyear Atomic Corp., Portsmouth, O.

[3] Haworth and Pryer, *Inst. Rubber Ind.*, 25, 265 (1949).

[4] Blow, *India Rubber J.*, 102, 610 (1942).

[5] Sanders, *Rubber Chem. Tech.*, 22, 465 (1949).

[6] Baruth, *Rubber Age (N.Y.)*, 63, 52 (1948).

[7] Moses and Rodde, India RUBBER WORLD, 119, 201 (1948).

[8] Photovolt Corp., 95 Madison Ave., New York 16, N. Y.

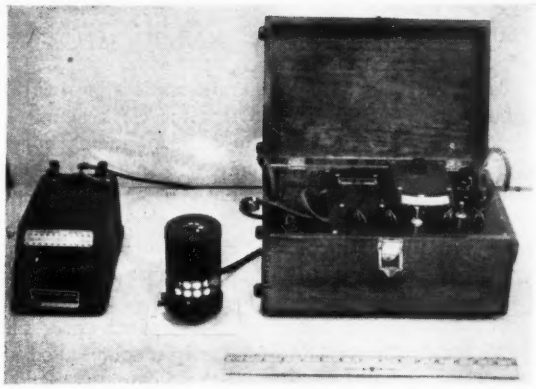


Fig. 1. Reflectance measuring equipment. The external mirror-type galvanometer on the left was used in place of the built-in galvanometer in the reflection meter on the right. The cylindrically shaped unit in the center is the search unit

The primary standard for adjustment of the galvanometer is a freshly smoked magnesium oxide surface. The working standard used, however, was a white enameled surface of about 75% reflectance, which had been calibrated against the primary standard by the National Bureau of Standards. The galvanometer was adjusted to obtain the proper scale reading for the working standard before measuring the reflectance of the test specimens.

The light aging equipment[4] consisted of two General Electric 275-watt RS-type sunlamps set 20 centimeters above the surface of the test samples. The latter are mounted on a circular steel plate, 17 inches in diameter which revolves at one rpm and which will accommodate 20 specimens (Figure 2). This arrangement is surrounded by a plywood cabinet 27 inches high raised one inch above the surface of the table (for air ventilation). No top is provided for the cabinet, and a side-opening door provides access to the test specimens.

Individual metal shields (Figure 3) cover the unexposed portions of each specimen and enable the removal of a single sample without disturbing the position of the other samples.

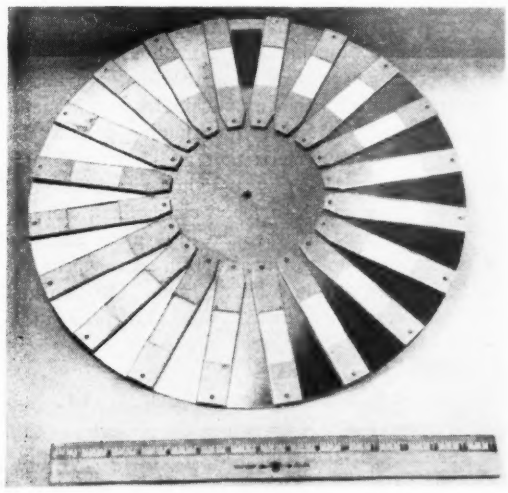


Fig. 2. Specimen holder and specimen shield arrangement for exposure of samples

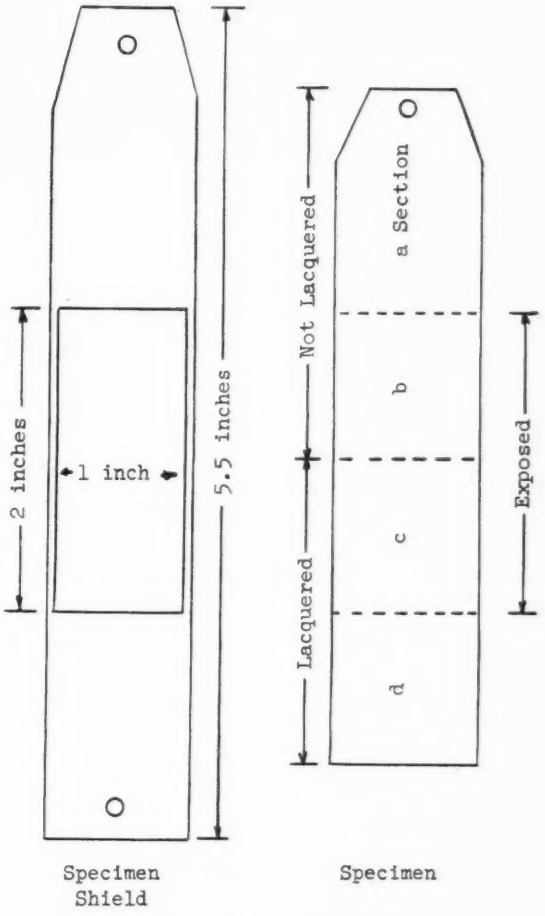


Fig. 3. Specimen and shield arrangement. Section a is unlacquered and unexposed; b is unlacquered and exposed; c is lacquered and exposed; and d is lacquered and unexposed

Experimental Procedure

Part I—Tests with Non-Staining Polymer

COMPOUND USED

	Grams
Polymer (GR-S 1502)	200
Zinc oxide	20
Sulfur	4
Benzothiazyl disulfide	3
Titanium dioxide reagent grade	20
Total	247

The purposes of the initial portion of the project were to determine whether holland cloth could be used rather than aluminum foil for preparing the cured slabs

and to establish the reproducibility of the test procedure. Two batches of GR-S 1502 (a non-staining, cold rubber) were mixed each day of a 10-day period, using the compounding recipe given above.

Two slabs (6 by 6 by 0.075 inch) were cured for 60 minutes at 292° F. from each compound, one between aluminum foil (0.006-inch thick) and one between holland cloth. From each of the four slabs, five strips (1 by 4½ inches) were cut, and a small hole was placed approximately ¼-inch from one end of the strip and used to hang the sample to dry after dipping exactly two inches of the other end in a thinned lacquer. The recipes for the standard lacquer and standard thinner follow:

STANDARD LACQUER

	% by Weight
Cellulose acetate-butyrate*	10
Rezyl 36-5†	3
Xylene	2
Titanium dioxide	3
Cellosolve acetate	25
Ethyl acetate	57
Total	100

STANDARD THINNER

	% by Weight
Cellosolve acetate	30
Ethyl acetate	70
Total	100

* Tennessee Eastman Type EAB-382-20. Tennessee Eastman Co., Kingsport, Tenn.
† American Cyanamid Co., plastics and resins division, New York 20, N. Y.

The consistency of the thinned lacquer was such that it yielded a continuous thin film on the specimen surface. The thinned lacquer was prepared by mixing 1½ parts of standard thinner with one part of standard lacquer. The specimens were suspended and dried at room temperature before being placed on a circular steel plate. Individual metal shields were placed on each specimen to permit the removal of any one test piece without disturbing the others. The shields were so constructed as to cover one inch at each end of the specimen, leaving the center portion (one inch lacquered and one inch unlacquered) exposed, thus dividing the test specimen into four sections, a, b, c, and d (Figure 3).

The samples were then exposed to the ultra-violet rays of two General Electric 275-watt RS-type sunlamps at a height of 20 centimeters. The circular plate revolved at one revolution per minute to assure uniform treatment of all samples. This method of testing was reported by Moses and Rodde[7].

Essential to the accuracy of the measurements is the timing of the period of exposure of the specimens. Because light sources vary in intensity, it is necessary for the purpose of comparison that the amount of exposure be measurable on the basis of a set of standards. Based on the extent of fading of light-sensitive paper E[9] prepared by the National Bureau of Standards and a set of color standards representing varying extents of fading of this light-sensitive paper during different exposure periods under the National Bureau of Standards Master Lamp, a carbon arc lamp, it is possible to equilibrate a light source so that the clock hours of exposure can be converted to standard fading hours (SFH) which in reality would be the clock hours of exposure under the Master Lamp.

For instance, with a light source weaker than that used at NBS, the number of clock hours of exposure required to fade the light-sensitive paper to a certain extent would be greater than the number of clock hours' exposure (standard fading hours) required under the NBS Master Lamp. Thus, for the light source used at the Government Laboratories, the following relation was found:

Clock Hours	Standard Fading Hours
2	*
21	8
26	10
31	12
36	14 (extrapolated value)

* Since there was no color standard for two hours of exposure, therefore there was no equivalent in terms of standard fading hours.

With the light source standardized with reference to the NBS Master Lamp, it was possible to refer to standard conditions under which changes occurred in the color of the test specimens of vulcanizates. Thus changes in light reflectance of the test specimens measured by the reflection meter, equipped with a scale reading 0 to 100, are in effect correlated with the fading of the light-sensitive paper E of the National Bureau of Standards. By comparing the light reflectance values of the exposed sections of the test specimen with the unexposed sections, the change that had occurred during light exposure could be determined.

Part II—Tests with Different NS Polymer

The second part of the program was to determine whether any quantitative differences could be detected between two types of non-staining antioxidants which were similar by qualitative test methods. This part of the program was the same as the first, providing an additional check on the reproducibility of the method, except that GR-S 1503 (a non-staining polymer from low-temperature polymerization and having the same monomer ratio as 1502) was used in place of GR-S 1502. The slabs were cured only between holland cloth, and light-sensitive paper E was used to determine the clock hours necessary to provide exposure equivalent to 8, 10, 12, and 14 standard fading hours. The two hours' clock-time exposure period was also used in this test.

Part III—Tests with Staining Polymer

The purpose of this portion of the project was to test the efficiency of the reflection meter for evaluating a non-staining polymer contaminated with very low per-

[9] Launer, *J. Research, Nat. Bur. Standards*, 41, 169 (1948).

centage of a staining polymer. Two batches each of the following 10 polymer combinations blended on the mill were evaluated in the same manner as the polymers in Part II of the program:

MIXTURES OF S AND NS POLYMERS

Sample No.	GR-S 1006* Grams	GR-S 1000† Grams	% Contaminant (GR-S 1000)
3A	400	0	0.00
3B	399	1	0.25
3C	398	2	0.50
3D	396	4	1.00
3E	392	8	2.00
3F	384	16	4.00
3G	376	24	6.00
3H	368	32	8.00
3J	360	40	10.00
3K	352	48	12.00

* Contains approximately 1.25 phr. of a non-staining antioxidant.
† Contains approximately 1.25 phr. of a staining antioxidant.

As an additional means of determining the efficiency of the reflection meter, batches were made up containing EPC black in percentages of 0.001, 0.0025, 0.005, 0.01, 0.02, 0.03, 0.05, and 0.1. To obtain extreme accuracy of the carbon black content, a standard white batch (see recipe shown under Part I) was prepared with 0.1% of black. This batch was then added to a standard white batch in increments to produce the amount of black required e.g., 1% of the batch containing black was added to 99% of the standard batch to produce a stock containing 0.001% black.

Results and Discussion

Part I—Tests with NS Polymer

The range, average, and standard deviation of the reflectance values obtained for the GR-S 1502 compounds are shown in Table 1. The standard deviation is a means of defining the variability of the test method; the larger the standard deviation, the lower the accuracy of the test. In general, the standard deviation is an estimate of the variation which would result during a large number of tests. If the distribution is normal about the average, then about two-thirds of the values measured should be within the range defined by the average value plus or minus the standard deviation; while 95% of the values measured should be within the range defined by the average value plus or minus 1.96 times the standard deviation.

For example, the data in Table 1 for the specimens cured between aluminum foil and exposed for 10 standard fading hours, unlacquered section, showed an average value of 59.02% reflectance and a standard deviation of 1.50% reflectance, indicating that during a series of 100 measurements on specimens prepared from the same polymer 95 of the reflectance values measured would be between 56.08 and 61.96% ($59.02 \pm 1.96 \times 1.50$). In other words, reflectance measurements made on the unlacquered section of two test specimens cured between aluminum foil and exposed for 10 standard fading hours could not be considered significantly different unless the values were outside the range 56.1-62.0% reflectance.

TABLE 1. RANGE, AVERAGE, AND STANDARD DEVIATION OF REFLECTANCE VALUES FOR GR-S 1502 COMPOUNDS

		Reflectance, %							
		Range‡				Range‡			
		High	Low	Average§	Std. Dev.	High	Low	Average§	Std. Dev.
		Aluminum Foil				Holland Cloth			
Exposure Period*	Section†								
2 clock hours	a	74.6	72.5	73.32	0.51	75.5	73.0	74.36	0.62
	b	75.0	72.1	73.15	0.71	75.0	72.6	74.05	0.71
	c	77.5	75.7	76.77	0.51	78.8	76.0	77.36	0.85
	d	78.0	76.9	77.34	0.29	79.2	76.4	77.92	0.73
8 SFH	a	75.4	71.5	73.23	0.88	75.1	73.4	74.09	0.57
	b	65.8	59.7	62.71	2.07	66.5	61.1	64.18	1.64
	c	75.7	73.4	74.75	0.58	76.4	73.4	74.95	0.88
	d	78.2	76.5	77.24	0.45	79.0	76.6	78.04	0.61
10 SFH	a	74.9	72.5	73.46	0.70	75.5	73.4	74.32	0.65
	b	61.5	56.5	59.02	1.50	63.3	58.0	61.33	1.46
	c	75.4	72.8	74.51	0.63	76.0	73.3	74.57	0.80
	d	78.0	77.0	77.37	0.48	79.0	77.1	78.21	0.58
12 SFH	a	74.8	72.0	73.15	0.76	75.0	73.0	74.21	0.62
	b	58.2	53.9	56.17	1.39	60.6	54.2	57.99	1.88
	c	75.4	72.9	74.21	0.71	75.4	72.5	74.02	0.87
	d	78.4	76.8	77.29	0.49	79.2	77.0	78.02	0.60
14 SFH	a	74.0	72.0	73.10	0.58	75.0	73.0	74.19	0.62
	b	57.5	50.7	53.41	1.61	58.2	52.3	55.58	1.64
	c	75.4	72.1	73.61	0.66	75.6	71.5	73.26	0.91
	d	78.4	76.5	77.39	0.52	79.0	76.6	78.07	0.63

* A standard fading hour (SFH) is a 60-minute period spent by a specimen under the NBS Master Lamp. A clock hour is a 60-minute period spent by a specimen under one or more sunlamps. Because of the possible use of lamps differing from the NBS Master Lamp, a clock hour is not necessarily equivalent to a SFH; but the clock hour can be equilibrated in terms of SFH with the use of color standards prepared by NBS.
† a — Unlacquered—unexposed. b — Unlacquered—exposed. c — Lacquered—exposed. d — Lacquered—unexposed.
‡ Each value represents the highest or the lowest value occurring among 20 values obtained from single determinations made on 20 specimens.
§ Each average is the average of 20 values from 20 specimens.

In general, higher reflectance values were obtained with the compounds cured between holland cloth than with those cured between aluminum foil, even though the impression of the texture of the cloth was evident on the surface of the slabs and the slabs cured between aluminum foil had a smooth, glossy finish.

The standard deviation calculated from the 10 day-to-day readings according to the equation

$$\text{Std. Dev.} = \sqrt{\frac{\Sigma X^2 - \Sigma X \left(\frac{\Sigma X}{N}\right)}{N-1}}$$

tended to be higher for the compounds cured between holland cloth, possibly because of the greater unevenness of the specimen surface. Higher standard deviations were obtained for the values of the exposed sections of the test samples. Part of this higher deviation was probably caused by the diminution of the intensity of the light with the hours of usage of the sunlamp, resulting in higher readings (less discoloration or staining) for the samples tested toward the end of the series. The relatively consistent values obtained for the reflectance of the unexposed sections of the test specimens (both unlacquered and lacquered) show not only that heat from the sunlamps did not cause discoloration or staining, but also that reproducibility of the whiteness of the unlacquered or lacquered surfaces was very good.

TABLE 2. REFLECTANCE VALUES FOR EXPOSED LIGHT-SENSITIVE PAPER

(Exposed with GR-S 1502 Compounds)

	Light-Sensitive Paper E*				
Exposure Hours:	2	21	26	31	36
Series No.	Reflectance, %				
1	16.5	23.4	24.9	26.0	28.4
2	16.5	22.6	24.1	25.6	27.1
3	17.0	23.0	24.7	26.0	27.2
4	16.6	23.0	25.0	25.8	27.3
5	16.8	23.6	24.4	26.3	29.2
6	16.6	22.4	23.9	25.6	26.4
	16.1	22.1	23.0	24.5	25.6
7	16.2	20.6	22.0	23.4	25.6
8	16.4	21.9	22.5	24.6	25.6
9	15.8	20.4	22.5	24.2	26.0
10	15.8	21.2	23.6	24.0	25.1

* The values listed for series 1 through 5 and the first set for series 6 were obtained using the old paper; the second set of series 6 values and those for series 7 through 10 resulted from the exposure of paper from a new supply. Each value represents a single determination.

Light-sensitive paper E from two different lots was used; the older paper (received in 1948) at the beginning of the series, and the newer paper (received in January, 1954), at the end of the series. Both papers were exposed during the preparation of the sixth set of samples for testing. The values obtained for the exposed papers are listed in Table 2. In general, lower reflectance readings were obtained with the newer paper, indicating either an inherent difference in the two lots of paper or a change in the rate of fac'ng of the paper on prolonged storage. The reflectance readings for the standard exposed papers (color standards for 8, 10, and 12 standard fading hours) supplied by the National Bureau of Standards were 25.2, 27.1, and 29.4%, respectively.

The clock hours of exposure for this part of the program did not exceed an equivalence of about 8 or 10 standard fading hours, as judged by the new and old light-sensitive paper E, respectively.

Part II—Tests with Different NS Polymer

The range, average, and standard deviation of the reflectance readings obtained with the GR-S 1503 compounds are shown in Table 3. The samples were cured between holland cloth only. Again, the highest standard deviation was noted for the exposed, unlacquered section reflectance values.

TABLE 3. RANGE, AVERAGE, AND STANDARD DEVIATION OF REFLECTANCE VALUES FOR GR-S 1503 COMPOUNDS

		Reflectance, %			
		Range†			
Exposure Period	Section*	High	Low	Average‡	Standard Deviation
2 clock hours	a	77.7	75.6	76.8	0.69
	b	77.5	75.0	76.3	0.83
	c	81.0	78.4	79.4	0.73
	d	81.5	78.8	80.1	0.80
8 SFH	a	78.3	75.6	77.0	0.65
	b	63.9	56.5	60.3	2.00
	c	78.8	75.4	76.7	1.00
	d	81.5	79.4	80.3	0.65
10 SFH	a	77.9	76.0	76.9	0.69
	b	60.0	53.4	56.4	1.83
	c	78.0	75.0	76.1	0.90
	d	81.5	78.8	80.2	0.64
12 SFH	a	78.2	75.0	77.0	0.85
	b	55.6	47.0	52.5	2.01
	c	76.5	74.1	75.1	0.71
	d	81.9	79.0	80.2	0.76
14 SFH	a	78.3	75.2	76.7	0.83
	b	51.8	46.4	50.4	1.38
	c	76.4	73.4	74.5	0.91
	d	81.8	78.5	80.0	0.90

* a — Unlacquered—unexposed.
b — Unlacquered—exposed.
c — Lacquered—exposed.
d — Lacquered—unexposed.
† Each value represents the highest or the lowest value occurring among 20 values obtained from single determinations made on 20 specimens.
‡ Each average is the average of 20 values from 20 specimens.

Although an attempt was made to obtain equivalent standard fading hours of exposure, as judged by light-sensitive paper E, the variation in reflectance readings for the exposed paper strips (Table 4) was as great as that experienced in Part I, where exposure was for a fixed period. The rubber test specimens were removed from the exposure apparatus at a time when the light-sensitive paper E exposed with the specimens appeared to be the same color as the NBS SFH test strip for the desired exposure period. The exact correspondence of the standard strip and the test strip of paper could possibly be obtained by repeated checking of the test strip at intervals with the reflection meter, interrupting the exposure period by removing the strips from the light aging cabinet to allow the paper to come to room temperature and humidity conditions, and then continuing exposure until the exact conditions had been

reached. A visual color comparison of the test strip and standard strip of light-sensitive paper E, however, generally provided a sufficiently accurate approach to the desired exposure period.

TABLE 4. REFLECTANCE VALUES FOR EXPOSED LIGHT-SENSITIVE PAPER E

(Exposed with GR-S 1503 Compounds)

	Light-Sensitive Paper E				
SFH:	2*	8	10	12	14
Series No.	Reflectance, %†				
1	16.1	25.0	25.6	29.4	31.6
2	16.3	24.7	26.7	29.4	31.4
3	15.8	24.0	26.5	28.6	31.4
4	16.5	24.5	26.6	29.5	31.2
5	16.4	24.6	27.0	29.5	31.5
6	16.3	25.6	28.5	29.6	31.0
7	16.5	25.0	27.6	30.0	32.7
8	16.5	24.6	27.0	29.5	30.6
9	15.4	23.3	24.9	26.8	28.9
10	18.8	22.0	29.0	30.2	32.0
NBS standard paper	—	25.2	27.1	29.4	—

* Clock hours.
† Each value represents a single determination.

It is apparent that the readings on the exposed sections should show higher deviations, since the period of exposure was dependent upon the visual judgment of a technician and therefore subject to human error. No trend toward lower reflectance values is evident in this case; however, the readings for the papers exposed with the ninth set of compounds are consistently low.

The exposed, unlacquered section readings (data not included) showed a minimum reflectance on the sixth day and a maximum reflectance on the seventh day; whereas the reflectance values for the paper were similar (25.6 and 25.0%) on the sixth and seventh days, as shown in Table 4, series Nos. 6 and 7 exposed for 8 SFH. The minimum reflectance readings for light-sensitive Paper E obtained on the ninth day, indicating the least equivalent fading, were not coupled with maximum reflectance values for the compounds exposed to the sunlamp at the same time. In general, correlation was relatively poor between the degree of fading indicated by the paper and the actual degree of discoloration or staining shown by the test compounds.

Part III—Test with Staining Polymer

The reflectance values of the a, b, c, and d sections of the test specimens from the batches with various percentages of contamination are shown in Table 5. The amount of discoloration as determined from reflectance meter values (the difference in readings for sections a and b), and the amount of staining (the difference in readings for sections c and d) are shown in Table 6. The % contamination is calculated on the basis of the amount of staining polymer (GR-S 1000) added to GR-S 1006 and not on the amount of contaminant (PBNA) present in GR-S 1000, so that the 0.25% contaminated compound actually has about 0.003% of PBNA. Variations in the reflectance reading with % contamination might differ to a certain extent from

TABLE 5. REFLECTANCE VALUES FOR GR-S 1006 COMPOUNDS*

Compound No.	Contaminant %	2 Clock Hours				8 SFH				10 SFH				12 SFH				14 SFH			
		a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
		Reflectance, %†																			
3A	0.00	80.1	79.7	81.9	82.6	80.0	54.9	77.6	81.6	80.2	50.7	77.7	82.5	79.8	46.4	76.7	82.9	80.3	44.4	76.1	82.7
3B	0.25	80.5	80.0	82.2	83.2	80.4	54.5	77.7	82.6	81.2	51.4	77.5	83.2	81.0	46.7	76.2	83.4	81.0	45.2	76.8	83.3
3C	0.50	81.1	80.5	82.7	83.6	80.9	55.5	77.0	83.2	81.0	51.0	76.9	83.1	81.2	46.7	75.3	83.2	81.5	44.1	76.1	83.2
3D	1.00	80.5	79.5	81.8	82.7	80.5	54.1	75.9	82.4	80.4	50.7	75.2	82.8	80.8	46.2	74.4	83.2	81.2	43.4	74.9	82.8
3E	2.00	80.0	79.2	81.0	82.4	80.0	53.0	73.8	81.7	80.0	49.6	73.9	82.2	80.4	44.6	72.6	82.4	80.6	42.6	73.0	82.1
3F	4.00	77.7	76.5	78.6	80.8	77.9	51.0	69.1	80.3	78.2	47.3	69.1	80.9	78.3	43.5	68.1	81.0	78.3	40.5	68.7	80.5
3G	6.00	77.2	75.7	77.6	80.3	77.4	49.2	65.5	79.9	77.5	45.8	64.1	79.9	77.2	41.1	62.5	78.4	77.1	38.4	64.1	79.7
3H	8.00	76.1	74.7	75.9	79.6	76.2	47.0	62.3	79.4	76.1	44.4	60.2	78.6	76.2	39.6	58.2	77.5	76.2	37.1	61.1	78.9
3J	10.00	74.8	73.2	74.4	78.3	74.8	45.2	59.0	78.0	75.1	41.6	58.6	77.8	75.2	37.7	56.3	76.6	75.1	35.8	55.1	77.9
3K	12.00	74.0	71.4	73.1	77.4	73.8	43.6	56.7	77.5	73.6	40.0	56.4	77.3	74.0	36.3	52.6	75.7	73.8	34.0	55.0	77.2

* The average of four values obtained in pairs on two different days for each of the following sections: a — Unlacquered—unexposed; b — Unlacquered—exposed; c — Lacquered—exposed; d — Lacquered—unexposed.

TABLE 6. ACTUAL DISCOLORATION AND STAINING VALUES

Contamination %	Discoloration*					Staining*				
	2 Clock Hours	Standard Fading Hours				2 Clock Hours	Standard Fading Hours			
		8	10	12	14		8	10	12	14
0.00	0.4	25.1	29.5	33.5	35.9	0.7	4.0	4.8	6.2	6.6
0.25	0.5	25.9	29.8	34.3	35.8	1.0	4.9	5.7	7.2	6.5
0.50	0.6	25.4	30.0	34.5	37.4	0.9	6.2	6.2	7.9	7.1
1.00	1.0	26.4	29.7	34.6	37.8	0.9	6.5	7.5	8.8	7.9
2.00	0.9	27.0	30.4	35.8	38.0	1.4	7.9	8.3	9.8	9.1
4.00	0.2	26.9	30.9	34.9	37.8	2.2	11.0	11.8	12.9	11.8
6.00	1.6	28.2	31.7	36.1	38.7	2.7	14.4	15.8	16.6	15.6
8.00	1.4	29.2	31.7	36.6	39.1	2.7	17.3	18.4	20.7	17.8
10.00	1.6	29.6	33.5	37.5	39.3	3.9	19.0	19.2	21.8	22.8
12.00	2.6	29.7	33.6	37.7	39.8	4.3	20.8	20.8	24.7	22.2

* Values are averages of readings obtained for four different specimens.

those reported here, particularly at the lower levels of contamination, if a different GR-S 1000 stock polymer were used.

It should be noted from the discoloration data in Table 6 that 12% contamination causes only about four reflectance-meter units change from the values recorded for the uncontaminated polymer specimens exposed to the sunlamp for the same number of standard fading hours.

At such low degrees of contamination, as used herein, irregularities of discoloration evidently occur with the increase in contamination. The time element in standard fading hours is of extreme importance when testing for contamination insomuch as the difference in discoloration (change in reflectance values) is as great for a difference of 2 SFH as for 12% of contaminating polymer. For example, compared to the extent of discoloration caused by 8 SFH of exposure of the uncontaminated sample (25.1), the additional discoloration caused by 12% contamination (29.7) is equal to that caused by two more standard fading hours' exposure of the uncontaminated sample (29.5), as shown in Table 6.

The differences in reflectance values of the staining (lacquered) portion of the strips as shown in Table 6, were more consistent with increases in contamination, and no irregularities were noted for the 8, 10, and 12 SFH tests of the specimens with 0.25 and 12% contaminant. The fairly constant difference of about 16 light reflectance units between the values of the uncontaminated and 12% contaminated specimens tested either at 8, 10, 12, or 14 SFH would tend to favor adoption of the shortest period, 8 SFH (about 24 clock hours), for specification testing.

The decrease in reflectance meter readings of sections a and d (Table 5) with an increase in contamination shows that the presence of the contaminant can be noted on the unexposed vulcanized slabs.

The actual hours of exposure and the reflectance values for light-sensitive paper E, determined in conjunction with the data shown in Table 5, are listed in Table 7. Strips of light-sensitive paper E were exposed on two, rather than 10, different days, which latter procedure was followed in Part II. The reflectance readings were in a numerical progressive order for the first day, but not for the second day. Also on the second day, approximately equal reflectance values were obtained for papers exposed for periods corresponding to 8 and 10 SFH and for 12 and 14 SFH, indicating that possibly equivalent exposure was obtained for the compounds (Table 5) exposed on the second day during the 8 and 10 SFH periods and for those exposed during the 12 and 14 SFH periods.

TABLE 7. REFLECTANCE VALUES FOR LIGHT-SENSITIVE PAPER (Exposed with GR-S 1006 Compounds)

Desired Exposure Period	Day		Day	
	1	2	1	2
	Reflectance, %		Clock Hours Exposed	
2 clock hours	16.7	16.6	2	2
8 SFH	24.4	26.0	23.5	25
10 SFH	26.5	25.6	30	30.5
12 SFH	30.5	31.7	44.5	44.5
14 SFH	33.6	31.4	50.5	50.5

In general, the reflectance values obtained for the exposed, unlacquered portions (section b) of the specimens showed a progressively greater discoloration with an increase in exposure time for specimens tested on the first and second days (data not presented). With the exposed lacquered portions (section c), however, the reflectance values obtained on the second day showed that about the same equivalent effect was obtained for specimens exposed for 8 and 10 SFH and 12 and 14 SFH, tending to corroborate the results obtained with light-sensitive paper E. The stained portions (section c) of the specimens tested on the first day (data not presented) showed less equivalent exposure after 14 SFH than after 12 SFH, although this does not agree with the reflectance values for the paper.

The compounds of GR-S 1503 prepared with 0.001 to 0.1% carbon black as a contaminant were exposed for 10 standard fading hours, as judged by light-sensitive paper E. The presence of as little as 0.001% of carbon black could readily be determined by the decrease in reflectance of the unexposed portions of the specimen, compared to the reflectance values for the uncontaminated polymer (Table 8). The actual dif-

TABLE 8. READINGS ON CARBON BLACK CONTAMINATED SAMPLES*

Stock No.	EPC Black %	Reflectance % a	b	c	d	Discoloration a-b	Staining d-c	Discoloration† %	Staining‡ %
A	0.000	77.1	50.4	76.6	80.6	26.7	4.0	34.6	5.0
B	0.001	74.3	50.2	74.2	78.4	24.1	4.2	32.4	5.4
C	0.0025	70.7	49.5	71.5	75.6	21.2	4.1	30.0	5.4
D	0.005	66.0	47.1	68.2	72.4	18.9	4.2	28.6	5.8
E	0.01	59.7	43.5	64.0	68.4	16.2	4.4	27.1	6.4
F	0.02	51.0	38.4	58.3	63.1	12.6	4.8	24.7	7.6
G	0.03	45.6	34.7	55.1	60.0	10.9	4.9	23.9	8.2
H	0.05	38.5	30.1	50.8	56.1	8.4	5.3	21.8	9.4
J	0.1	28.6	23.1	45.6	51.0	5.5	5.4	19.2	10.6

* a Unlacquered—unexposed; b Unlacquered—exposed; c Lacquered—exposed; d Lacquered—unexposed.

† $\frac{a-b}{a} \times 100 = \%$ discoloration.

‡ $\frac{d-c}{d} \times 100 = \%$ staining.

ference in reflection meter units between the unexposed, unlacquered sections of the uncontaminated and 0.001% contaminated specimens was 2.8; while the difference between that of the uncontaminated specimen and that of the specimen containing 0.1% of black was 48.5 units. The discoloration (a minus b) was affected more markedly than was the staining (d minus c), since the lacquer coating tends to mask the effect of the carbon black to some extent. The discoloration decreased and the staining increased with an increase in the quantity of black.

Comparison of Results for Parts I, II, and III

It should be noted that the relations which were established between polymers may show some variation when different lots of the same polymers are used. For example, the small differences in characteristics between GR-S 1502 and 1503 might not be found when two other samples with different histories of drying and handling are used.

In general, the standard deviations of the reflectance values for the various sections of the test specimens from the GR-S 1502 compounds used in Part I were lower than those for corresponding sections of the GR-S 1503 specimens tested in Part II. The unexposed sections of the GR-S 1503 specimens had consistently higher reflectance values than the GR-S 1502 specimens in this particular case. The percentage decrease in reflectance for the unlacquered section on exposure was greater for GR-S 1503 than for GR-S 1502, showing more discoloration for the former polymer; the staining characteristics of the two polymers, as judged by the percentage decrease in reflectance values for the lacquered section on exposure, were equal. A statistical analysis of variance of the % reflectance readings for the specimens of either GR-S 1502 or 1503 showed that the day-to-day variance was greater than the variance between the two mill-mixed compounds tested on the same day.

The results obtained showed that a two-hour exposure period was insufficient to produce definite amounts of discoloration and staining; whereas significant differences were apparent after an exposure period corresponding roughly to 8 SFH.

The standard deviations of the reflectance values for light-sensitive paper E (Table 9) were of about the same order of magnitude in Part I and Part II, except for the papers exposed for a two-clock hour period for which the standard deviation was lower in Part I than in Part II.

TABLE 9. MEAN AND STANDARD DEVIATION OF REFLECTANCE VALUES FOR LIGHT-SENSITIVE PAPER E

Exposure Period	Part I Mean	Part I Std. Dev.	Part II Mean	Part II Std. Dev.
2 clock hours	16.4	0.38	16.5	0.90
8 SFH	22.2	1.08	24.3	1.02
10 SFH	23.7	1.05	26.9	1.22
12 SFH	25.1	0.98	29.3	0.96
14 SFH	26.7	1.29	31.2	1.00

The correlation between the reflectance values for the strips of light-sensitive paper and those for the synthetic rubber specimens exposed simultaneously was relatively poor in some instances. Therefore, because of the decrease in the intensity of the light emanating from the RS-type sunlamp with prolonged usage, the use of the paper is necessary in order to obtain roughly equivalent exposure periods for samples tested at different times.

Summary and Conclusions

1. The reproducibility of the reflectance values for the unexposed sections of the test specimens was very good, generally within a range of 1% on either side of the mean value. The greater variability of the values for the exposed sections was probably caused by the variation in the total quantity of incident light received by specimens exposed on different days.

2. Compounds of GR-S 1503 showed higher reflectance values for the unexposed sections than those for GR-S 1502. Discoloration was greater for GR-S 1503, but the staining characteristics, although not pronounced, were equal for GR-S 1502 and 1503.

3. A statistical analysis of variance of the reflectance values for compounds of GR-S 1502 and 1503 showed that the day-to-day variance was greater than the variance between the two mill-mixed compounds tested on the same day.

4. The effect of GR-S 1000 contaminant on the discoloring and staining characteristics of GR-S 1006 compounds was readily ascertainable when the contaminant level was above 1%, whereas below that level no real differences between the contaminated and uncontaminated specimens could be determined.

5. The reflection meter will show differences between vulcanized slabs of white stocks containing no carbon black and those with as little as 0.001% carbon black.

6. The decrease in reflectance of the test specimens provides a numerical value for discoloration and staining which is related to the actual reflectance ratings.

7. An exposure period roughly equivalent to 8 SFH was sufficient to produce determinable amounts of discoloration and staining: while a two-clock hour exposure period was too short.

8. Holland cloth is a satisfactory material for covering the compounds during vulcanization. Slightly greater variability in reflectance values was obtained with the compounds cured between holland cloth than with those cured between aluminum foil.

9. The reflection meter can be operated accurately by non-technical personnel.

Specifications for a Chemist

(*Continued from page 63*)

By statistical inference we may estimate the true average value of a tested property, from the test of a small number of samples. By statistical design we may design an experiment so that we will get information of the desired precision at a minimum cost, or we may adjust results from an experiment, already made, to allow for sources of variation, which were present.

Quality control is much advertised. In a statistical sense, the capabilities of the production method are determined and deviations are established by statistical control. Here again the application of effort is minimized.

Sampling to get representative results, at minimum cost, is another statistical achievement.

Summary and Conclusions

I had now been led through the labyrinth of rubber laboratories with the assurance of my host that an understanding of all of these things was necessary for the rubber chemist who would boast that he is fully experienced in all branches of rubber chemistry. I reflected that Dr. Elastomer must be the only man in the world who could claim this status. And yet there are numerous rubber chemists who must be familiar with a large portion of this great field of technology in order competently to carry on their jobs.

I said as much to Dr. Elastomer. He smiled and whispered, "There is one more requirement. He must be a psychologist and, to some extent, an economist. Thereby he will learn to interpret the demands of his boss so that they may be transformed into useful rubber goods when needed and at a minimum cost. He must be able to transform his own technical language into plain everyday English, so that the boss will not expect the impossible or ask for the (economically) wrong thing."

Then he added, with a twinkle in his eye, "Perhaps his greatest trial is to listen to lectures on rubber chemistry that add nothing new to his knowledge."

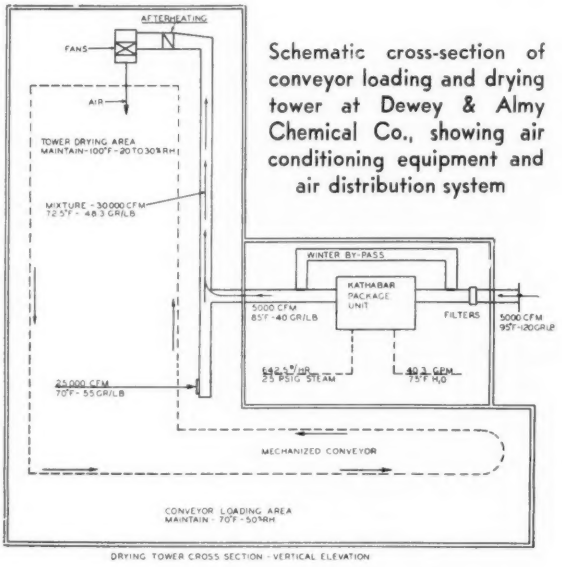
This, then, describes the technical background of the modern rubber chemist. Is this not a profession which can be pursued with pride and intellectual satisfaction? Does it not call for the very best effort of the very best men available? I think the answers are in the affirmative, and I use this means of saluting the rubber chemist—an important figure in our industrial society. Whether he draws from the riches of the past or prepares for the brilliance of the future, he may walk in the dignity of a true servant of mankind.

Kathabar Unit Chemically Dries Meteorological Balloons

Chemical-type humidity conditioning is being used by Dewey & Almy Chemical Co., Cambridge, Mass., to dry its meteorological balloons under exact conditions found best for this phase of production, according to Suface Combustion Corp., Toledo, O., manufacturer of the equipment used.

Known as the Kathabar dehumidification system, the conditioner removes from 1½ to two pounds of moisture from each balloon in preparing it for the final curing, inspection, and packaging, by maintaining, continuously and automatically, 20-30% R.H. at 100° F. in the drying tower, the Toledo firm declared.

The equipment uses a lithium chloride-base solution to absorb moisture from the air. Controlling the temperature of the solution controls the amount of moisture absorbed so that exact requirements of moisture content can be met regardless of outside conditions, the company explained.



Schematic cross-section of conveyor loading and drying tower at Dewey & Almy Chemical Co., showing air conditioning equipment and air distribution system

DRYING TOWER CROSS SECTION - VERTICAL ELEVATION

EDITORIAL

New Classification System for Basic Raw Materials Needed

THERE is a real need of a new and complete classification and identification system for the basic raw materials used and produced by the rubber industry. *New raw materials are introduced with increasing frequency, and a reevaluation and redefinition of the elastomeric as well as the non-elastomeric materials are essential to reduce the growing confusion in terminology.*

In October, 1955, we called attention in this column to the need of a synthetic rubber producers organization to counteract the dislocation in the rubber industry resulting from the transfer of ownership and operation of the GR-S type rubber plants from government to private industry. Of special significance was the possibility of the chaos that might result if the system of classification and specification for GR-S type polymers developed during the period of government operation was not retained in some semblance of its original state.

It was pointed out also last October, that the American Society for Testing Materials, through its D-11 Committee on Rubber, was handling, at the request of the synthetic rubber producers, the important job of arranging for the former government methods of test to be converted to ASTM standards. It was suggested that the problem of devising generally acceptable nomenclature and definitions might require more rapid handling than the technical society could manage.

The GR-S type synthetic rubber producers apparently do not feel a trade association is necessary at the present time, and meanwhile the ASTM D-11 Committee has made remarkable progress in getting the test methods ready for approval as national standards. *Progress in developing acceptable definitions and coding for GR-S type polymers has been somewhat slower.*

In connection with this latter problem it became known to the editor of RUBBER WORLD that The Rubber Manufacturers Association, the Commerce Department, and the Rubber Division of the American Chemical Society, as well as the ASTM, were all concerned with the problem of definitions and coding, not only for GR-S type materials, but for all elastomeric and non-elastomeric materials used by the industry.

It has been possible to bring together, under the auspices of the ASTM, representatives of the above-mentioned interested organizations to discuss these problems in a preliminary way. *The following major groups and sub-groups of materials are being considered as a possible basis for an all-inclusive classification and identification system for the basic raw materials used and produced by today's rubber industry:*

I. Elastomers
   A. Vulcanizable
      1. Diene rubbers
      2. Non-diene rubbers
   B. Non-vulcanizable or other elastomers
II. Hard Plastics
III. Reinforcing Resins
IV. Paint Vehicles

To work out the details of the entire system will require much time, effort, and cooperation on the part of all interested parties. A new, complete, and generally accepted classification system is very much needed at the present time, however. *Comments from* RUBBER WORLD *readers and support from industry management are solicited in view of the very great importance of this project.*

R. G. Seaman

EDITOR

Meetings and Reports

Rubber Division, ACS, Cleveland Meeting Program Extensive; Includes Invited Paper

The Division of Rubber Chemistry of the American Chemical Society will meet separate from the parent Society at the Hotel Cleveland in Cleveland, O., May 16-18. An excellent and diversified program of technical papers has been arranged and will include an invited paper by the first secretary of the Division, Arnold H. Smith, retired. The title of this invited paper is "The Rubber Division 1919-27 as I Remember It."

The technical sessions will begin on Wednesday afternoon, May 16, at 2:00 p.m., with 1956 Division chairman, A. E. Juve, B. F. Goodrich Co. Research Center, presiding. Papers at this first session will be concerned primarily with new polymers. At the second session on Thursday morning, the Division vice chairman, B. S. Garvey, Jr., Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., will preside, and this session will hear papers devoted to the degradation effects of various materials on elastomers and new methods of chemical and physical analysis of elastomers and compounds. The third session on Thursday afternoon will have Director-at-Large D. C. Maddy, Harwick Standard Chemical Co., presiding, and the papers will be concerned with carbon blacks. The final session on Friday morning will include papers on compounding and general-interest papers, and the presiding officer will be C. A. Smith, New Jersey Zinc Sales Co., who is chairman of the local committee on arrangements for this meeting.

The authors of the best paper given at the Division meeting held in Philadelphia, Pa., November 2-4, 1955, J. D. Sutherland and J. P. McKenzie, Copolymer Rubber & Chemical Corp., will receive their award at the Cleveland meeting. A selection for the best paper at this Cleveland meeting will also be made since this is now a regular feature of all Division meetings.

The business meeting of the Division will be held during the latter part of the Thursday morning session, and nominations for new officers and directors, and the name of the 1956 Goodyear Medalist will be announced, and various other committee reports will be heard.

The Division banquet will be held on Thursday evening in the Hotel Cleveland. There will be no formal speeches, and an outstanding entertainment program has been arranged.

There will be a luncheon meeting of the Division's 25-Year Club at noon on Wednesday. F. W. Stavely, Firestone Tire & Rubber Co., is chairman for this event.

Arnold H. Smith, the first secretary of the Division and author of the invited paper to be presented at the Thursday morning session, is a graduate of Armour Institute of Technology. He was a research chemist at the National Bureau of Standards and then worked for the Goodyear Tire & Rubber Co. and The Thermoid Rubber Co. before joining the Rubber Service Laboratory of Monsanto Chemical Co. in Akron, O., in 1922. Mr. Smith became technical sales manager of the Rubber Service Laboratory and then in 1929 was sent to England to establish and direct the manufacture of rubber chemicals at a Monsanto affiliate in that country, where he was a director from 1932 until 1940, when he returned to the United States. He became a director of the parent company's foreign department in 1945 and served for one year as managing director of Monsanto Chemicals (Australia), Ltd., before joining Monsanto Canada, Ltd., as president in 1948. He retired in 1953 under provisions of the company's retirement plan.

The local committee on arrangements, headed by C. A. Smith, will be set up for registration in the Hotel Cleveland from 4:00 to 9:00 p.m. on Tuesday, May 15, as well as on Wednesday morning, May 16. The chairman is arranging for a program for the ladies attending the meeting although the person in charge of the ladies' program had not been selected by late March. No plant trips are planned because of the heavy schedule of technical papers.

Other members of the local committee follow: vice chairman, Earl B. Busenburg, The B. F. Goodrich Co.; registration, Harry Brubaker, Witco Chemical Co.; meeting room arrangements, W. Von Fisher, Case Institute of Technology; finance, W. T. Hall, C. P. Hall Co.; banquet, Emil H. Krismann, E. I. du Pont de Nemours & Co., Inc.; and housing, W. D. Parrish, B. F. Goodrich Chemical Co.

Program and Abstracts of Papers

Wednesday Morning—May 16

9:00 a.m. Registration.

12:00 noon. 25-Year Club Luncheon Meeting. F. W. Stavely, chairman.

Wednesday Afternoon—May 16

New Polymers
A. E. Juve, Presiding

2:00 p.m.—1. Introductory Remarks. A. E. Juve.

2:05 p.m.—2. Recent Advances in Isocyanate Chemistry. R. G. Arnold,[1] J. A. Nelson, J. J. Verbane, du Pont, Wilmington, Del.

Although certain aspects of isocyanate chemistry are more than a century old, rapid development of isocyanate technology has occurred only during the past decade. Impetus for this work resulted from the successful use of these compounds in the synthesis and modification of polymers.

Diisocyanates and polyisocyanates are of commercial interest because of their versatile reactivity. Because of their extreme sensitivity to catalysis by acids and bases, however, reaction kinetics are complicated, and the primary reactions of isocyanates with alcohols, amines, and water are often accompanied by side reactions, many of which have not been recognized previously. Proper control of catalysis permits the rapid formation of high molecular weight polyurethanes and ureas. Further, the use of catalysts such as inorganic bases, tertiary-amines, and phosphines allows the synthesis of such simple polymerization products as dimers and trimers.

Sensitive analytical techniques for the determination of isocyanate reaction products such as biuret, allophanate, dimer, trimer, amine, etc. have been developed. These have proved useful in defining the detailed structure of certain complex polymer systems derived from isocyanates.

2:35 p.m.—3. Butadiene/2-Methyl-5-Vinylpyridine Copolymers for General-Purpose Use. H. E. Railsback and C. C. Biard, Phillips Petroleum Co., Bartlesville, Okla.

Butadiene-vinylpyridine copolymers have long been recognized as giving promising physical properties in conventional formulations. These copolymers are compatible with commercial processing oils, and highly extended stocks exhibit good stress-strain properties and high resilience. Because of the inherently poor scorch resistance exhibited by elastomers containing pyridyl groups, however, these copolymers have not been studied extensively as general-purpose rubbers.

Compounding studies of butadiene-methylvinylpyridine (Philprene VP-15 and VP-25) copolymers have shown that acceptable processing safety can be achieved in compounds containing these elastomers. A combination of low sulfur level, a sulfur donor (dithio-dimorpholine), and a conventional accelerator gives scorch resistance comparable to that exhibited by butadiene-styrene rubber stocks. In the improved formulation these unique elastomers display high modulus, good low-temperature properties, and excellent laboratory abrasion resistance.

Butadiene-methylvinylpyridine rubbers respond to the normal reinforcement associated with HAF, ISAF, and SAF type carbon blacks and are highly reinforced by mineral pigments in tread-type formulations. The latter compounds are characterized by high modulus, excellent hysteresis properties, and outstanding laboratory abrasion resistance.

Butadiene-methylvinylpyridine copolymers appear easily adapted to general-

[1] Name in bold face indicates person presenting the paper.

purpose use and should offer significant advantages over conventional rubbers for certain types of service.

3:00 p.m.—4. Variations in Alfin Polymerization of Butadiene.[2] **Avery A. Morton,** Massachusetts Institute of Technology, and Bram B. Boonstra, Godfrey L. Cabot, Inc., both of Boston, Mass.

Alfin polymerization is unique in that it occurs upon a solid surface. The character of the polymer is determined by the composition and physical condition of that surface. The salts used were the three simplest possible for an Alfin reagent: namely, allylsodium, sodium isopropoxide, and sodium chloride. The variations studied were (a) the proportions of sodium isopropoxide to allylsodium, (b) the difference between freshly prepared and aged reagents—a purely physical effect, and (c) the proportions of reagent to monomer.

Polymerizations were carried out in a two-gallon autoclave and all at the same initial temperature (26° C.) and concentration of butadiene, 900 milliliters per 6,000 milliliters pentane. The yield was a pound or more of polybutadiene in the better cases. The results are reproducible when the above variables are controlled.

The results show that the optimum yield is not obtained with large amounts of the most active ingredient, allylsodium, but rather at ratios of isopropoxide to allylsodium of 1.7 to 2.0. Changes which occur as each preparation ages are most interesting because they represent solely a physical change in the reagent. The yield increases rapidly during the first five days. Even with a very active catalyst this increase in yield will amount to 20%. With less active agents the increase will be 100% or more. Freshly prepared reagents, as a rule, cause a lower temperature rise per given yield of polymer. The reason is not clear at the moment, but a comparative freedom from accompanying side reactions may be indicated. For freshly prepared reagents the viscosity decreases with the amount of reagent.

The results in compounding work with oil-extended Alfin polymers follow in general the changes in composition and age of the reagent. Alfin polymerization can be controlled and reproduced if attention is paid to the condition of the reagent as well as the temperature concentration and other factors used in polymerization.

3:25 p.m.—5. Stability of Emulsion Polydienes. Maurice Morton and Michel Montu, University of Akron, Akron, O.

A study has been conducted on the effect of polymer treatment on the solubility and intrinsic viscosity of emulsion polydienes. The polymers studied were polybutadiene, polyisoprene, and polychloroprene.

The results showed that the treatment of the emulsion polymers had a very important bearing on their solubility and intrinsic viscosity. In general, polybutadiene is much less sensitive to treatment variables than either of the other two. However, the treatment conditions, e.g., temperature, presence of oxygen, shortstop, and antioxidant, are a very important factor, as well. In addition, the type of polymerization recipe also enters into the question.

For polybutadiene and polychloroprene, it appears to be important to protect the polymer from cross-linking reactions, which lead to gel formation. This point is especially important for the detection of any microgel which may be present in the original polymer. In the case of polyisoprene, on the other hand, it appears to be possible to obtain both cross-linking and oxidative degradation, depending upon conditions.

The importance of the above factors in the laboratory evaluation of emulsion polydienes is discussed.

3:50 p.m.—6. New Polymers from Natural Rubber. L. C. Bateman, The British Rubber Producers' Research Association, Welwyn Garden City, Herts, England.

Recent work at the BRPRA on the preparation and characterization of graft and block copolymers of natural rubber with synthetic polymers is reviewed.

In homogeneous solution or in latex, polyisoprenes can be combined with polymerizing monomers to form graft copolymers. On the basis of theory, experiments with low molecular polyisoprenes, and the general characteristics of the reactions with rubber, it would appear that interaction reflects chain transfer activity of the polyisoprenes—but there is one serious anomaly, *viz.*, a peculiar specificity with respect to the initiating catalyst. The application of solvent fractionation and chemical degradation to the characterization of the interpolymers is outlined, and some interesting physical and technological properties are indicated.

The preparation of block copolymers from solid rubber follows as a natural consequence of the recent elucidation of the chemistry of mastication processes. The primary reaction under appropriate shearing conditions during mastication is the mechanical rupture of the rubber molecules into free radicals which then display the same reactivity as those generated in more conventional systems. Thus they can initiate the polymerization of vinyl monomers, with polymer growth proceeding from the end of the initiating rubber radical. Such reactions can be readily realized provided certain not very stringent conditions are met: the most fundamental are (1) application of adequate shear to produce the primary radicals, and (2) the absence of free radical inhibitors, e.g., oxygen. This method of copolymer formation is of wide general application both as regards the base polymer and the reactivity of the monomer and its chemical and physical nature.

A. E. Juve, Division Chairman

Arnold H. Smith,
Division Secretary, 1919-1927

4:20 p.m.—7. New Curing System for Silicone Rubber. M. L. Dunham, D. L. Bailey, and R. Y. Mixer, Silicones Division, Union Carbide & Carbon Co., New York, N. Y.

Improved performance of silicone elastomers has been obtained by a new curing system. Di-*tert*-alkyl peroxides have been employed as novel curing agents. The cure is obtained through pendant alkenyl and methyl groups by means of a peroxide-induced free radical mechanism. Vinyl and cyclohexenyl groups attached to silicon are among the alkenyl groups studied. The cross-link is considered to be a trimethylene bridge in the case of the vinylsiloxy group.

Blends of dimethyl silicone gums and vinyl-containing gums can be covulcanized. The concentration of vinyl groups has an extensive effect on the properties of the cured elastomers. Carbon black fillers are practical when the di-*tert*-alkyl peroxides are employed in the vinyl-containing gums. Black-filled compounds exhibit very high electrical conductivity which is essentially unaffected by milling or processing procedures.

4:35 p.m.—8. Properties and Uses of a New Vinyl Containing Silicone Rubber. J. H. Lorenz and M. L. Dunham, Union Carbide.

New low compression-set values are obtained with vinyl-containing silicone rubber compounds without the use of additives. Other unique properties of these new materials include improved resistance to high-pressure steam and improved solvent resistance. When cured with di-*tert*-butyl peroxide, thick sections of these compounds can be postcured immediately at 480° F., eliminating the stepwise procedure. Practical utilization of di-*tert*-butyl peroxide is achieved by a low-volatility masterbatch.

[2] This work was performed as part of a research project sponsored by the National Science Foundation.

Properties of vinyl-containing silicone gums compounded with 12 different fillers are presented. Comparative data using four curing agents show the versatility of the compounds.

New or improved applications made possible by this rubber include thick section coatings for steel rolls for the textile, paper, printing, and plastics industries. Silicone rubber containing vinyl groups can now be used as gaskets on steam autoclaves, as oil seals in transmissions and as brake cups. Electrically conductive stocks filled with carbon black may serve as wireless heating pads in airplane deicers, or as molding blankets; conductive silicone rubber components can serve to ground static electricity in many industrial applications.

Thursday Morning—May 17

Degradation and Analysis
B. S. Garvey, Jr., Presiding

9:00 a.m.—9. Oxidation Rate Measurements: Effect of Compounding Variations of *Hevea* Rubber Vulcanizates. A. G. Veith, Goodrich Research Center, Brecksville, O.

The oxidation of *Hevea* vulcanizates (with some minor exceptions) is described by a two-parameter equation of the form

$$r = r_o + k_a (O_2)$$

where r = instantaneous oxidation rate
r_o = initial rate
k_a = autocatalytic constant
(O_2) = amount of O_2 consumed

An equation of this form has been found by others to apply to the oxidation of simple olefins.

Correlation calculations show that both r_o and k_a are linearly related to the amount of organically bound sulfur. Variations in r_o and k_a are found among vulcanizates accelerated with various accelerators. The parameters r_o and k_a have different temperature coefficients and therefore represent rate limiting steps of different activation energy.

The effect of some inorganic fillers and carbon blacks on the oxidation behavior was determined. Under equal surface area conditions zinc oxide, calcium silicate, and clay result in lower values of r_o and k_a than a control with no filler. Both furnace and channel blacks slightly decrease k_a, while r_o is increased above that of the control. The increase of r_o varies linearly with the surface area of carbon black per gram of rubber as shown by correlation calculations. Values for k_a decrease slightly over this range.

9:25 a.m.—10. The Effect of Natural Gas Combustion Fumes on Latex Foam Products. Donald M. Holkestad, Research Laboratories, Firestone Tire & Rubber Co., Akron.

Latex foam rubber compounds are designed to give maximum aging protection in service, by the incorporation of suitable rubber antioxidants. Occasional cases of severe surface failure have been reported, however, after short periods of service. This investigation was concerned with the determination of the cause of failure and a study of means for its prevention.

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Division Vice Chairman

This unusual surface failure was duplicated in the laboratory by exposing foam rubber to natural gas combustion fumes. Further work revealed that the nitrogen oxides, particularly nitrogen dioxide, present in small quantities in the fumes, were causing the failure.

An accelerated aging test was developed to evaluate the relative protective abilities of various antioxidants and compounds. Some antioxidants, considered very active by ordinary heat aging standards, were not effective for nitrogen dioxide protection. Several antioxidants were found, however, which inhibited attack by the nitrogen oxides.

It was concluded that in the selection of antioxidants the latex foam compounder must consider nitrogen oxide protection, in addition to the usual requirements for protective agents.

9:45 a.m.—11. The Influence of Nitrogen Dioxide on Aging of Foam Rubber. H. L. Goebel and E. G. Bargmeyer, United States Rubber Co., Mishawaka, Ind.; P. D. Brass and J. U. Mann, U. S. Rubber Research Laboratories, Passaic, N. J.

In recent years it has been noticed that certain foam rubber articles, e.g. pillows, mattresses, and some furniture items, deteriorated very markedly in scattered areas throughout the country. This deterioration was not traceable to any of the normal aging factors. Work described in this paper indicates that the causative agent is nitrogen dioxide or related oxides of nitrogen, and that the deterioration of the foam is especially severe in places where homes or rooms are heated by unvented gas heaters.

These oxides of nitrogen are also responsible for the discoloration of antioxidants, or of rubber by antioxidants.

An apparatus in which gases resulting from the combustion of natural gas are circulated around foam rubber samples is described. This apparatus is believed to duplicate rather closely the conditions under which deterioration in service occurs.

An apparatus in which samples of foam rubber may be exposed directly to measured concentrations of NO_2 is also described. Test results obtained on this and the gas flue apparatus are discussed. The effect of a selected group of antioxidants and of some compounding ingredients on this type of aging is described.

Hevea, GR-S type, and acrylonitrile latex foam products have been studied as well as vinyl plastisol and polyurethane foams.

10:10 a.m.—12. Determination of Ozone in Air. C. W. Wadelin, Research Laboratory, Goodyear Tire & Rubber Co., Akron.

The method of Crabtree and Kemp for the determination of ozone in air has been modified to eliminate the need of a correction factor for the volatility of iodine. The ozone from the sample is absorbed in a 2% potassium iodide solution which contains a measured excess of sodium thiosulfate. The excess thiosulfate is then backtitrated with 0.001 *N* potassium iodate to an amperometric end-point.

The apparatus for detection of the end-point consists of a calomel electrode, a platinum electrode, and a sensitive galvanometer. No batteries or resistors are required. On triplicate analyses of eight samples ranging from 15 to 20 pphm., a standard deviation of 1.45 was found. By varying the concentrations of the solutions, samples containing from 2 to 10,000 pphm. of ozone can be analyzed.

10:30 a.m.—13. Absorptiometric Microdetermination of Zinc Oxide in Rubber Products Using Sodium Diethyl Dithiocarbamate. K. E. Kress, Firestone.

An ultra-violet absorptiometric micro method for determination of zinc oxide has proved suitable in analysis for this important component in all types of rubber products.

A 1 to 5 mg. sample is either rapidly dry ashed to 550° C., or preferably wet ashed with perchloric acid. The acid soluble zinc is precipitated as the white zinc diethyl dithiocarbamate from weakly alkaline solution. The precipitate is extracted with ethyl ether, and the measured absorbance in ether at 262 mμ or 285 mμ is used to calculate zinc oxide content of the sample. A turbidimetric modification has also been investigated.

This rapid micro method is very sensitive. Accuracy is believed to be superior to present titration methods for rubber product analysis. The method has been successfully applied to analysis for zinc in a wide variety of organic and inorganic materials used in rubber compounding. The rare interference of other elements forming colored carbamates (e.g., cobalt, nickel, and copper) is easily detected and can be corrected for by an absorbance difference method.

10:50 a.m.—14. A Zinc Oxide Viscosity Test for *Hevea* Latex. H. G. Dawson, Firestone Research Laboratories.

The chemical stability of *Hevea* latex usually means the stability to zinc oxide, since the ammonium salts of the water soluble acids present in the latex serum react with zinc oxide in the presence of free ammonia and natural soaps to cause latex thickening during processing. By measuring the increase in viscosity with time (using a Brookfield viscosimeter) after treating latex with soap, a sensitizer, and zinc oxide, it is possible to measure the zinc oxide

stability of the latex. The test requires only 20 minutes to run; it is sensitive and reproducible.

The zinc oxide viscosity (ZOV) test has been valuable in studying the effect of (1) aging *Hevea* latex at various temperatures, (2) ammonia concentration and preservative, and (3) variations in serum solids due to clonal differences or centrifugal purification upon the zinc oxide stability of latex. The test has been most valuable in predicting the processing behavior of *Hevea* latex in the production of foam rubber and other rubber products.

11:10 a.m. Business Meeting.

11:30 a.m.—15. The Rubber Division 1919-1927 as I Remember It. Arnold H. Smith, Webster Groves, Mo. An invited paper.

The author, who was the first secretary of the Rubber Division and who continued in that office from 1919 to 1927, gives his reminiscences of the period. The difficulties of the initial formation are described as well as some of the efforts to organize alternate groups of rubber chemists.

The conditions then prevailing in the industry and the contributions of various individuals, manufacturing companies, and supply companies are discussed. The early growth of our Division and many of the turning points of those days are related by a member who was actively engaged in these affairs during the entire period.

Thursday Afternoon—May 17

Carbon Blacks
D. C. Maddy, Presiding

2:00 p.m.—16. Analysis of the Structure in Channel Black Dispersions. I. Stabilized Systems. Andries Voet, J. M. Huber Corp., Borger, Tex.

It has long been known that particle size and surface area of a carbon black are of prime importance in determining its characteristics in dispersions. Increasing evidence has been brought forward to indicate that the tendency of the particles to adhere to one another and to form loosely bound aggregates (structures) is of great importance.

Recently developed electrical methods have clarified our insight into the processes of particle interaction. The dielectric constant of a carbon black dispersion allows conclusions about the shape of the agglomerates; while the D.C. conductivity indicates the extent of formation of particle networks.

This investigation presents a series of electrical measurements on dispersions of channel black in a mineral oil over wide ranges of concentrations, temperatures and rates of shear.

It has become abundantly clear that the elementary carbon particle is not moving freely in the dispersion, but a much larger irregularly shaped aggregate appears to be the kinetic unit, even at higher rates of shear. In systems in which the particles have been stabilized by an electrical charge as well as by steric protection by means of an adsorbed film of polar material, the kinetic units associate to form larger association complexes.

These complexes are partly coiled at rest, uncoil at low rates of shear, and are

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destroyed at higher shear rates. The time required for rebuilding these complexes varies from a few seconds to several hours, depending upon concentration and temperature. Higher temperatures and lower concentrations reduce particle interaction.

In stabilized systems interlinked particle networks are not apparent.

2:20 p.m.—17. Analysis of the Structure in Channel Black Dispersions. II. Unstabilized Systems. Andries Voet.

Extensive electrical measurements indicate that in unstabilized systems the association tendencies of the primary carbon black aggregates are greatly increased, resulting in the formation of more extensive association complexes and an increased structural involvement. In addition, a process of reticulation, the formation in interlinked particle networks, becomes apparent.

In dilute systems association clearly precedes reticulation; while in concentrated dispersions both processes run more or less simultaneously.

Application of low rates of shear to the carbon black in oil dispersion will effectively destroy the reticulation, but the breaking up of the association complexes of primary aggregates requires a much higher shear rate. The time required to cause the structural changes is very short in sheared systems, but in quiescent dispersions the rebuilding of structures is a very slow process.

In unstabilized systems an increase in temperature strongly promotes both reticulation and association. Thus extensive hysteresis phenomena are expected in quiescent dispersions, which were actually observed.

Rheological data are misleading, since the measurement itself destroys the effect to be measured.

2:50 p.m.—18. The Reinforcement of Butyl Rubber with Carbon Black—Heat Treatment with FT Black. S. R. Shuart and A. M. Gessler, Enjay Laboratories, Linden, N. J.

Heat treatment of some butyl rubber-carbon black masterbatches leads to significant improvements in chemical and physical properties of the resulting vulcanizates. Data on butyl-FT black systems indicated that little response is obtained as a result of heat treatment.

The most unusual effect of heat treatment observed to date is, however, the response obtained with butyl-FT black systems containing plasticizer. Tensile strength, instead of decreasing, is increased as plasticizer is added to the compound. The normal diluent effect of the plasticizer on breaking strength is thus reversed, and the vulcanizate with 20 parts of plasticizer possesses a tensile strength double that of the vulcanizate without plasticizer. In addition, this vulcanizate has high plasticity and snap and in test exhibits dynamic properties equivalent to those of a first-line natural rubber inner tube.

Data are presented to support a postulated theory of this phenomenon and the possible relation between black and polymer. Physical properties, the effects of plasticizer concentration, and mixing techniques required to obtain the desired effects are discussed. Applications of this compound, along with possible variations for adaptation to other applications, are presented.

3:15 p.m.—19. The Chemistry of Reinforcement. II. Scorch in Natural Rubber Stocks Containing Carbon Black. Merton L. Studebaker and Lester G. Nabors, Phillips Chemical Co., Akron.

Hydrogen sulfide is probably always produced during vulcanization of rubber with sulfur, and its importance in vulcanization has been emphasized repeatedly. Craig[3] *et al.* have suggested that the formation of hydrogen sulfide controls scorch, probably by reactions involving the accelerator and hydrogen sulfide which result in the liberation of sulfur atoms or radicals.

One function of zinc compounds is to buffer the hydrogen sulfide concentration. Carbon black also reacts with hydrogen sulfide and hence affects its concentration level in the rubber compound. It might be expected, therefore, that the reactivity of carbon black with hydrogen sulfide would be one of the factors which affect the scorchiness of loaded rubber stocks.

This reactivity is examined experimentally at vulcanizing temperatures and related to the properties of the carbon black. It is shown that the scorch data of MBT[4] and Santocure[5] accelerated natural rubber stocks loaded with various carbons can be correlated with (1) the amount of carbon black surface in the mixtures and (2) the oxygen content of the carbon black. This latter factor determines the reactivity of carbon black with hydrogen sulfide—probably because hydrogen sulfide adds to the quinoid structure which has previously been demonstrated to be present on the carbon black surface.

3:40 p.m.—20. Measurement of Dispersion in Black-Loaded Rubber. C. H. Leigh-Dugmore, Dunlop Research Center, Birmingham, England.

Reinforcement of rubber by finely divided fillers such as carbon black depends on their fineness; their reinforcing ability

[3] *J. Polymer Sci.*, 8, 321 (1952).
[4] Mercaptobenzothiazole.
[5] N-cyclohexyl-2-benzothiazole sulfenamide. Monsanto Chemical Co., Rubber Chemicals Department, Akron, O.

is not fully exploited unless individual particles are separated as much as possible, that is, unless they are completely dispersed.

Assessment of dispersion against this criterion (ultimate dispersion) can be made with the electron microscope, but the technique is too unwieldy for regular use. It is sufficient for most purposes to know the gross dispersion, or the proportion of the filler which is in the form of aggregates smaller than about six microns.

Gross dispersion is measured by examining sections two or three microns thick under the light microscope. Sections are cut with a sledge-type microtome having a freezing stage. The proportion of the field of view devoted to aggregates larger than about six microns is counted with the help of an eyepiece graticule divided into squares. This proportion is converted simply to an estimate of the proportion of the total filler in the stock, dispersed as aggregates smaller than six microns.

The method has been found suitable for testing the efficacy of mixing processes and is simple enough for routine laboratory use. It has been found appropriate for rubber-like polymers and for polyethylene and has been shown reproducible in different laboratories.

4:05 p.m.—21. Effects of Mixing Time on Properties Imparted to Rubber by Reinforcing Carbon Blacks. I. Drogin, United Carbon Co., Inc., Charleston, W. Va.

The effects of mixing time on the properties of carbon black reinforced butadiene-styrene rubber, butadiene-styrene oil-extended rubber, natural rubber, and butyl rubber have been studied because the unprecedented increase in the use of new rubber the past few years has taxed mixing facilities and has put greater emphasis on faster processing in the rubber industry. This emphasis has led to shorter mixing cycles, higher rotor speeds, and high-pressure or high-horsepower mixing to attain the maximum production per unit.

This paper describes (1) the effects when the first-stage mix or masterbatch is Banbury mixed for as short a time as 1½ minutes and as long as 12 minutes; and (2) the effects of working the masterbatch on the sheet-off mill as long as eight minutes immediately after its discharge from the Banbury.

Reducing the mixing cycle time of a masterbatch results in a lower temperature and in less power consumption. The final batch has higher viscosity, shorter scorch time, greater shrinkage, more nerve, thicker extruded gage, duller appearance, roughness, lower modulus, higher elongation, lower resistance to abrasion, higher resistance to tear, lower heat build-up, practically no change in tensile strength, hardness, resiliency, and flex (cut-growth), higher electrical conductivity, and poorer dispersion.

Extended working of the masterbatch on the sheet-off mill, immediately after its discharge from the Banbury, scarcely improves the physical properties of the final batch, with the exception that its electrical conductivity decreases with longer milling. It appears to be futile to retain a masterbatch on the sheet-off mill for a longer period than is required for cooling and batching off for later processing.

Provided there are sufficient air pressure on the ram and sufficient horsepower to operate the Banbury properly, and the plant facilities are properly designed for rapid feeding to the Banbury, and rapid incorporation of the ingredients, and handling the mixings most effectively, a Banbury mixing cycle time of two minutes for the masterbatch would not, for all practical purposes, detract materially from the physical properties of the final batch. A longer mixing cycle may be desirable from a processing angle, however, to reduce viscosity and thereby decrease nerve, shrinkage, and swell, depending upon the end-use of the compound.

7:00 p.m. Division Banquet.

Friday Morning—May 18

Compounding and General
C. A. Smith, Presiding

C. A. Smith, Local Committee Chairman

9:00 a.m.—22. The Swelling of Nitrile Rubbers by Blends of Isooctane and Toluene. Ross E. Morris and Paul T. Wagner, Mare Island Naval Shipyard, Vallejo, Calif.

A 70/30 by volume blend of isooctane and toluene is commonly used to evaluate the resistance of a rubber to gasoline. The swelling of the rubber caused by the solvent mixture is an important criterion of this resistance. The authors have investigated a feature of this swelling which has not been previously considered: namely, the relative distribution of the solvent components between the solvent phase and the rubber. Vulcanized gum nitrile rubbers of various acrylonitrile contents were used. Radioactive toluene was used to facilitate analysis of the absorbed solvents.

It was found that toluene is preferentially absorbed from the mixtures. The results obtained indicate by interpolation that if a rubber of about 39% acrylonitrile content were immersed into the 70/30 solvent blend, the volume ratio of isooctane and toluene in the nitrile rubber at equilibrium would be 11/89. If a 50/50 solvent blend were used, practically no isooctane would be absorbed; essentially all of the solvent in the swollen nitrile rubber would be toluene. The tendency for preferential absorption of toluene lessens as the acrylonitrile content of the rubber is decreased.

9:25 a.m.—23. Properties of a Carboxylic Nitrile Rubber (Hycar 1072). C. H. Lufter and N. G. Duke, Goodrich Chemical, Avon Lake, O.

Carboxylic bearing monomers have been combined with butadiene and acrylonitrile to give a nitrile rubber having unusual and seemingly useful characteristics. The unusual properties which result from the carboxylic polymer are primarily due to the reactions in which the polymer chain may be involved owing to the active hydrogen of the carboxyl group.

This paper discusses properties of the vulcanizates of the carboxylic nitrile rubber and makes direct comparison with a normal nitrile rubber counterpart.

The carboxylic rubber shows more versatility than normal nitrile with respect to methods of vulcanization. Excellent cures can be obtained by the use of bivalent metal oxides or salts alone. Certain properties: namely, compression set, are improved by using a combination metal oxide-sulfur cure system. The mechanism of bivalent metal vulcanization is discussed briefly.

It is possible to use low-volume loadings of carbon black to give compounds having greatly improved low-temperature brittleness properties without the traditional sacrifice of oil resistance. Other properties exhibiting significant improvement over normal nitrile rubbers are abrasion resistance and hot elongation. Oil resistance of the carboxylic nitrile rubber is equal or superior to that of standard nitrile counterparts.

The presence of the carboxyl groups has altered the polymer in such a way that the physical characteristics of blends with vinyl resins and phenol-formaldehyde resins are changed from those normally obtained from blends of these resins with typical nitrile rubbers. Blends of the carboxylic nitrile with polyvinyl chloride produce stocks with greatly improved processibility. Vulcanization of the rubber portion of such blends also demonstrates some advantages for the carboxylic nitrile. Phenolic resins appear to be more compatible with the carboxylic nitrile rubber and produce highly reinforced blends.

The carboxylic nitrile rubber is now commercially available from the B. F. Goodrich Chemical Co., Cleveland, O., under the name Hycar 1072.

9:45 a.m.—24. Effect of Diester Lubricants on Elastomeric Materials. Ralph M. Harper and J. Hartley Bowen, Jr., Aeronautical Materials Laboratory, Naval Experiment Station, Philadelphia, Pa.

During the past five years the use of diester lubricants in military aircraft has increased rapidly. The use of these diester lubricants was necessary in order to extend the aircraft operating temperature range from below —65 to above 400° F. Nearly all high-performance aircraft now require lubricants of this type in the form of oils or greases.

Elastomeric materials and articles are required in the form of hose, O-rings, gaskets, and other mechanical goods to contain these lubricants in aircraft systems.

Data are presented showing the effect of di-2-ethyl hexyl sebacate and its homologs, and also commercial diester lubricants on various elastomeric materials at temperatures ranging up to 350° F. At temperatures up to 300° F., nitrile rubbers based on polymers containing 30% or more acrylonitrile provide the most favorable diester resistance. Other oil-resistant polymers, such as low acrylonitrile content nitrite materials, neoprene, and thiorubbers, are unsuitable because of excessive swelling and/or deterioration. At temperatures above 300° F., polyacrylates or fluorinated acrylates provide favorable diester resistance, but are deficient in low-temperature flexibility.

Operation of aircraft including its elastomeric components under conditions of high temperature is the most serious concern at present. Unless new polymers having greatly improved high-temperature diester resistance are developed, the engineers responsible for the design of future military aircraft, missiles, and extreme-altitude vehicles will have their problems increased by the necessity of designing entirely new mechanical devices in which elastomeric materials are eliminated.

10:10 a.m.—25. Breakdown of Oil Masterbatch GR-S Polymers with Various Antioxidants. W. K. Taft, **June Duke,** Dorothy Prem, Government Laboratories, University of Akron, Akron.

Antioxidants of the staining and non-staining types were added to separate portions of a high Mooney viscosity GR-S 1500 type of polymer (iron-pyrophosphate with rosin acid). Each series was coagulated without oil and with 37.5 parts of Circosol-2XH,[6] Sundex 53,[6] and Dutrex 20[7] per 100 parts of polymer, vacuum dried, and aged at 140° F. to establish the parameters of breakdown.

Apparently the most stable polymers and masterbatches were obtained with beta-conidendrol,[8] with respect to tendency to form gel, extent of polymer stability before breakdown, and rate and extent of breakdown. The non-staining antioxidants, in general, did not prevent gellation during heat aging, but caused preliminary stability prior to breakdown which then proceeded at rather rapid rates. The non-staining antioxidant, 2,2'-methylene bis (4 methyl-6 tertiary butyl phenol) (Antioxidant 2246)[9] gave practically no preliminary polymer stability, but prevented gel formation with the polymer being intermediate in rate of breakdown, but not in the ultimate amount of breakdown.

Polymers and masterbatches containing the staining antioxidants did not gel, in most cases. These antioxidants caused generally the least preliminary polymer stability and the fastest rates of breakdown with, however, the exception of beta-conidendrol. Ditertiary butyl hydroquinone generally protected the polymer the least. The aforesaid generalities are more precise when applied to the results obtained with the base polymer and the Circosol-2XH masterbatches, and less precise, but relatively the same when applied to the results obtained with Dutrex 20. The results of the Sundex 53 masterbatches maintained a position intermediate to those of the masterbatches made with the other two oils.

[6] Sun Oil Co., Philadelphia, Pa.
[7] Shell Oil Co., New York, N. Y.
[8] Gamma lactone of complex substituted naphthoic acid.
[9] American Cyanamid Co., Rubber Chemicals Department, Bound Brook, N. J.

10:35 a.m.—26. Composition and Classification of Rubber Processing Oils. S. S. Kurtz, Jr., J. S. Sweely, R. W. King, S. W. Ferris, Sun Oil Co., Marcus Hook, Pa.

It is shown that the composition of rubber processing oils is related to specific gravity, viscosity, and refractive index. With only these three easily determined pieces of experimental data the composition of rubber processing oils can be obtained in terms of percentage of carbon atoms in aromatic rings, percentage of carbon atoms in naphthenic rings, and percentage of carbon atoms in paraffinic chains.

The study of such composition data shows that a relation between viscosity and gravity known as the viscosity-gravity constant gives a good first approximation of the carbon type composition. The viscosity-gravity constant is essentially independent of molecular weight. Viscosity itself is a function of molecular weight; so the use of viscosity and viscosity-gravity constant provides a good simple system of classifying rubber process oils.

The terms, paraffinic, relatively paraffinic, naphthenic, relatively aromatic, aromatic, and very aromatic, are defined and given quantitative definition in terms of viscosity-gravity constant and composition.

Processibility, volatility, low-temperature properties, and degradation and oxidation effects are discussed in relation to the proposed classification. Naphthenic and aromatic oils are superior to paraffinic in processibility. Paraffinic and naphthenic oils are superior to aromatic oils in low-temperature properties. The lower the molecular weight of the oil the better the low-temperature properties. Degradation and oxidation effects are greatest with aromatic oils and much less with naphthenic and paraffinic oils. A simple relation is shown between viscosity-gravity constant of the extender oil and the degradation of oil-extended rubber.

Volatility is bad with oils of 300 molecular weight. With 400 molecular weight oil there is a little volatility, and at 450 it is negligible. A graph for getting molecular weight from viscosity at 210° F. and VGC is presented. The relation between aniline point and VGC is discussed. The amount of material removed by treatment with 85% sulfuric acid is an indication of the non-hydrocarbons and reactive aromatics present. The lower this value is the better as far as stability of the oil.

Lack of compatibility, that is, the tendency to bloom out, is not a problem in the use of extender oils in styrene-butadiene type rubbers. In the case of Neoprene Type WHV and nitrile type rubbers, blooming out is a problem. In comparing processing oils for use in chloroprene and nitrile type rubbers the percentage of saturated material which can be separated by silica gel is very important as well as the carbon type composition of both the saturated and aromatic fraction. The selection of oil for use in chloroprene and nitrile type rubbers is a far more complicated problem than in the case of this styrene-butadiene type where blooming out is relatively unimportant.

11:05 a.m.—27. New Structural Compounds. Chas. L. Petze, Delaware Research & Development Corp., Wilmington.

During the last several years non-tire uses of rubber have grown in volume at a relatively higher rate than in previous years, despite the recent marked increase in the production of motor vehicles. In large measure these opportunities for the rubber industry have arisen from needs of new types of compound. In the words of Thomas Hancock, it is still the "elastic property [of rubber] that is so valuable." But we now are able better to preserve the toughness of rubber while obtaining values of flexural modulus, degrees of processibility and of machineability, levels of electrical and dielectric properties, and other characteristics that promise to make rubber products more attractive to more design engineers.

This paper will describe work done over the last six years to develop new compositions of matter, on which patent applications have been filed, employing silicones and other rubbers to obtain novel properties required for several severe service applications, especially in the growing electronics field. The property specifications, which largely rule out conventional compounding practices, will be summarized.

Data will be presented on attainment and maintenance of impact strength under continuous outdoor exposure, of high surface electrical resistance in the wet and dirty state, of low dielectric loss, together with information on dimensional stability under cyclic pressure and temperature conditions, on reduction of internal strain, and on processibility.

Uses cited for these new materials will include 60-pound multi-band, omni-directional antenna radomes machined to complex contours, microwave antenna lenses for radio-relay links and communications networks as well as for radar, end seal and strain insulators, some for installations in the Arctic, and wire coatings for high temperature service. All of these uses depend in large part upon the stability and hydrophobic properties of these new compounds.

Symposium and Article Reprints Available

Reprints of the Akron Rubber Group's symposium and panel discussion entitled, "Rubber Meets the Challenge of Modern Transportation," which was featured in our March issue, are available at 35¢ each.

Reprints of the article, "Ozone Cracking of Natural and Synthetic Rubbers," by James E. Gaughan, the lead article in the March issue, are also available at 35¢ each.

Orders should be addressed to RUBBER WORLD, 386 Fourth Avenue, New York 16, N. Y.

ASTM Committee Week Includes D-11; D-24 on Carbon Black Organized

Committee Week of the American Society for Testing Materials was held at the Hotel Statler, Buffalo, N. Y., during the week of February 27. Nineteen subcommittees of Committee D-11 on Rubber and Rubber-Like Materials held meetings prior to the meeting of D-11 on March 2. An organizational meeting of a new Committee D-24 on Carbon Black was also held. There were also meetings of many other technical committees.

The 1956 Committee Week featured a Symposium on Properties, Tests, and Performance of Electrodeposited Metallic Coatings.

A Special Administrative Committee on Nuclear Problems has been organized by the Society and is headed by N. L. Mochel, Westinghouse Electric Corp. The scope of this special committee is as follows: (1) to advise the technical committees of the Society on nuclear problems pertinent to their respective scopes; (2) to stimulate the undertaking of research and standardization projects, specifically related to nuclear energy, on the part of the technical committees; (3) to review periodically the status of the work.

The activities of Committee D-11 and its subcommittees are reported below; the organization meeting of Committee D-24 will be reported separately.

D-11 Committee Meeting

Committee D-11 held its meeting on the morning of March 2. Simon Collier, Johns-Manville Corp., chairman, presided and was assisted by A. W. Carpenter, secretary.

It was announced that the "Glossary of Terms Relating to Rubber and Rubber-Like Materials," ASTM Special Technical Publication 184, as prepared by a subcommittee of D-11, was now available from the Society headquarters. The price is $3 per copy to non-members and $2.25 to ASTM members.

The minutes of the last annual meeting of July, 1955, were approved, including the results of the June, 1955, letter-ballot and the additional letter-ballot of October, 1955. These 1955 letter-ballot recommendations of Committee D-11 were approved by the Society's Administrative Committee on Standards in January, 1956.

Certain changes have been made in the chairmen of the various subcommittees because of resignations of previous chairmen. These changes are as follows: Subcommittee 1 on Hose, R. A. Bonnell, Goodyear Tire & Rubber Co., replaces C. P. Mullins, Gates Rubber Co. Subcommittee 9 on Insulating Tape, C. D. Pickells, Consolidated Edison Co. of N. Y., replaces R. H. Titley, Public Service Electric & Gas Co. of N. J. Subcommittee 18 on Flexing Tests, Howard Tangenberg, The B. F. Goodrich Co., replaces B. S. Garvey, Jr., Pennsylvania Salt Mfg. Co. Subcommittee 23 on Hard Rubber, W. J. Dermody, Stokes Molded Products, replaces C. P. Morgan, Vulcanized Rubber & Plastics Co.

In addition, S. S. Kurtz, Jr., Sun Oil Co., replaces J. F. Anderson, B. F. Goodrich, as D-11 representative on Committee D-16 on Industrial Aromatic Hydrocarbons. Also, an additional representative on Committee D-20 on Plastics from D-11, and representatives on E-1 Committee on Methods of Testing, subcommittee 16 on thickness measurement, and the subcommittee on microchemical analysis, will be appointed from D-11.

The next meeting of Committee D-11 will be held as part of the annual meeting of the Society in Atlantic City, N. J., during the week of June 17. Two technical papers are scheduled for presentation before the D-11 meeting, one on the use of mathematical statistics in rubber testing, by E. M. Bader, of Goodrich, and the other on a comparison of hardness testing instruments by C. K. Chatten, of the U. S. Navy Department's Bureau of Ships.

D-11 Subcommittee Meetings

Subcommittee 1—Hose. R. A. Bonnell, Goodyear Tire & Rubber Co., chairman. This subcommittee recommended certain revisions in D296-49, Standard Specifications for Cotton Rubber-Lined Fire Hose, for immediate adoption as standards by the Society at the annual meeting. These revisions will bring the ASTM standards in line with the standards of the Underwriters Laboratories and take into account the use of synthetic fibers in fire hose. Also included will be a change in the title of D296-49.

The subcommittee also discussed revisions in D380-51T, Methods of Testing Rubber Hose, and expects to complete this discussion at the next meeting in June, after which recommendations for changes in D380-51T will be made.

Subcommittee 5—Wire and Cable. John T. Blake, Simplex Wire & Cable Co., chairman. The report of the task group appointed to study the possibility of including wire and cable compounds into a classification system for rubber compounds not now included in D735-54T, Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications, and as suggested by subcommittee 16 on Classifications and Specifications for Rubber Compounds, stated that wire and cable compounds should not be included in the proposed system.

A proposal to include detailed specifications on knitted coverings, wrapped coverings, and nylon, rayon, and glass braid coverings in D1350-54T, Specifications for Construction of Rubber Insulated Wire and Cable, was referred to the specifications section for study.

Proposals to change D1351-54T, Specifications for Polyethylene Insulated Wire and Cable, to include the use of the newer experimental polyethylenes are to be held in abeyance until recommendations on these polyethylenes are received from Committee D-20 on Plastics.

The subcommittee decided to restrict D752-54T, Specifications for Heavy-Duty Neoprene Sheath for Wire and Cable, to black neoprene jackets and to raise the physical test requirements of D753-54T, Specifications for Light-Duty Neoprene Sheath for Wire and Cable, so that the latter may be used for general-purpose colored neoprene jackets. When finalized, these recommendations will be submitted for letter-ballot.

The subcommittee decided against publishing wire and cable specifications in a separate pamphlet as agreed upon previously.

Subcommittee 6—Packings. F. C. Thorn, Garlock Packing Co., chairman. A request was received from section 10, SAE-ASTM Technical Committee on Automotive Rubber, for amendments to D1147-53T, Method of Test for Compressibility and Recovery of Gasket Materials. With some minor changes these amendments will be submitted for letter-ballot in Committee D-11.

Progress reports were made on work on relaxation, sealability, and revision of D733-53T, Methods of Testing Compressed Asbestos Sheet Packing. Actual work is being done in section 10 of SAE-ASTM Tech A Committee, but will be cleared with subcommittee 6.

The section investigating a specification for the round gaskets used in asbestos-cement pipe reported that no technical difficulties were involved in preparing such a specification, but there were differences of opinion as to the necessity for it. An attempt will be made to resolve these differences.

Subcommittee 8—Nomenclature. H. L. Fisher, University of Southern California, chairman. There was no meeting of this subcommittee, but it was announced that the "Glossary of Terms Relating to Rubber and Rubber-Like Materials," ASTM STP 184, would be available from the Society headquarters in the near future.

Subcommittee 9—Insulating Tape. C. D. Pickells, Consolidated Edison Co., chairman. Revisions to D69-52T, Specifications for Friction Tape for General Use for Electrical Purposes; D119-48T, Specifications for Rubber Insulating Tape; and, D1373-55T, Specifications for Ozone-Resistant Rubber Tape, were approved by letter-ballot in the subcommittee. It was decided, however, to give further consideration to improving the procedures for sampling, testing, and rejecting samples in these specifications.

The subcommittee decided to revise the fusion test in D1373-55T because the present test does not recognize that tapes made of synthetic rubber do not have the "quick tack" of tapes made of natural rubber, a characteristic which does not, however, affect the performance of the tape in service.

Subcommittee 10—Physical Testing. L. V. Cooper, Firestone Tire & Rubber Co., chairman. This subcommittee recommended for letter-ballot in Committee D-11 tentative specifications and methods of test for O-rings.

The revision of paragraph 3f, on testing machine calibration, of D412-51T, Method of Test for Tension Testing of Vulcanized Rubber, although approved by letter-ballot

in the subcommittee, was referred to a task group headed by W. N. Keen, of E. I. du Pont de Nemours & Co., Inc., for further study.

A tentative method for tension testing with the strain tester of the National Bureau of Standards will be letter-balloted in the subcommittee.

A discussion of equivalent cure and the proper method for curing ½-inch compression slabs resulted in general agreement that these problems must be faced by some subcommittee of D-11.

Subcommittee 13—Synthetic Elastomers. B. S. Garvey, Jr., Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., chairman. Section 1 on sampling reported that with the help of subcommittee 28 on Statistical Quality Control a recommended sampling method had been prepared and would be submitted to letter-ballot in the subcommittee. Further work is required on the method of sampling for the determination of volatile matter.

Section 2 on chemical test methods recommended eight methods of test and a method of sampling, for letter-ballot in Committee D-11. The eight test methods consisted of volatile matter by the hot-mill method, volatile matter by the mill-oven method, total ash, water soluble ash, carbon black in masterbatch, bound styrene, organic acid, and soap.

Section 3 on physical test methods was unsuccessful in its attempts to get agreement on changes necessary for incorporation of the test formulae, compounding and mixing procedures from the former "Specifications for Government Synthetic Rubbers" of the Federal Facilities Corp. into D15-54T, Methods of Sample Preparation for Physical Testing of Rubber Products. The section was reconstituted and will now attempt to prepare for submission to Committee D-11 for adoption as new tentative ASTM methods, sections D-4, -5, -6, -7, on recipes, mixing procedures, equipment, and curing and testing from the above-mentioned FFC specifications.

Section 4 on latex test methods reported agreement on seven methods of test and a sampling method and recommended these for letter-ballot in Committee D-11. Total solids, residual styrene, pH, surface tension, viscosity, coagulum, and bound styrene were the items for which the test methods were recommended.

Section 5 on nomenclature now recommends for letter-ballot in Committee D-11 the definition "styrene rubber" and the abbreviation SB for the butadiene-styrene copolymers formerly referred to as "GR-S," and "butadiene rubber" and the abbreviation BR for the polybutadiene rubbers also formerly referred to as "GR-S." In the latex form these materials would be defined as "styrene rubber latices" and abbreviated as SR latices, and "butadiene rubber latices" and abbreviated as BR latices. This section was asked to provide definitions for "net" and "gross" rubber in connection with oil, carbon black, and oil-carbon black masterbatches.

Section 6 on standard reference materials reported financing of the preparation of a 30,000-pound lot of cold SR rubber for preparation of a standard sample seemed assured with the help of the producing companies. Details of handling, testing, and distribution of this standard lot will be worked out between producer representatives and representatives of NBS.

Section 7 on code numbers recommended for letter-ballot in Committee D-11 a table of SR descriptions and also a table of suggested numbers for polymers which do not fit into the SR table.

Subcommittee 15—Life Tests. G. C. Maassen, R. T. Vanderbilt Co., chairman. Mast Development Co. presented a movie and discussion of its newly developed apparatus for the ozone testing of rubber. [A description and illustration of this apparatus appears in the New Equipment section of this issue—EDITOR.]

C. W. Wadelin, Goodyear, presented information pertaining to an improved method for determining ozone concentration in rubber testing.

A proposed revision of D518-44, Method of Test for Resistance to Light Checking and Cracking of Rubber Compounds, was discussed and then referred back to the task group for changes in the title and scope of D518-44, following which the proposed revisions will be recommended for incorporation in the method as section C.

Subcommittee 16 — Classification and Specification of Rubber Compounds. J. F. Kerscher, Goodyear, chairman. The four different systems of classifying rubber considered by the subcommittee at its previous meetings were reviewed briefly by the chairman.

The results of a questionnaire which had been circulated within the subcommittee on the classification method involving a modification of ASTM D735-54T were discussed. Answers were about three-quarters affirmative with regard to the use of the modified D735 system, but there was a significant minority objection which indicated the need of further understanding of this and the other classification systems with special reference to how they would be useful for various product specifications. A task group of subcommittee 5 on Wire and Cable submitted a report wherein it rejected the modified D735 system. Other groups representative of the heel and sole and hose and belting branches of the industry also indicated dissent with this system.

R. D. Stiehler, National Bureau of Standards, and an American delegate to the ISO/TC 45 Committee meeting in Dusseldorf, Germany, in September, 1955, reported on that meeting. It was agreed that the ISO/TC 45 document No. 252, which represents the results of the ISO/TC 45 Working Group No. 6's discussion of the modified D735 *versus* the Netherlands N 1001 system of classification and WG 6's recommendation for a possible compromise solution, would be reviewed by subcommittee 16. A task group of subcommittee 16 will be appointed by the chairman to prepare a questionnaire on this matter to be circulated within subcommittee 16.

Copies of the minutes of meetings of subcommittee 16 will be forwarded to the members of the ISO/TC 45 Working Group No. 6, starting with the minutes of this March 1, 1956, meeting.

Subcommittee 17—Hardness, Set, and Creep. S. R. Doner, Manhattan Rubber Division, Raybestos-Manhattan, Inc., chairman. Dr. Stiehler reported that the United States recorded the only negative vote on the ISO/TC 45 Draft Recommendation No. 50 on "The Determination of Hardness," and that the method was modified so that the ISO/TC 45 hardness scale now reads within about two points of the American Shore D instrument scale throughout the range. The vote of the United States has therefore been changed to affirmative through the American Standards Association, the official American organization in ISO/TC 45.

The ISO/TC 45 Draft Recommendation No. 50 will be submitted for letter-ballot in Committee D-11 and inclusion in the ASTM D-11 Handbook.

It was pointed out that the ISO/TC 45 hardness procedure is apparently based on use of the English Wallace "foot operation" instrument. Experience with this instrument to date indicates that it is not suitable for use at low temperatures because of frictional features inherent in the design of the instrument.

A preliminary report was made on a round-robin testing program being conducted with several hardness testing instruments. Data from five of the nine participating laboratories have been received.

It was suggested by the chairman that subcommittee 17 should investigate the use of the microdurometer for hardness testing of rubber as developed by Stefano Oberto, of the Pirelli company of Italy, and reported in the October-December, 1955, issue of *Rubber Chemistry and Technology*.

It was announced that Mast Development Co., Davenport, Iowa, is manufacturing the "Material Laboratory-Admiralty Indentometer," as developed by the Navy Department Bureau of Ships.[1]

N. Tillotson, of Tillotson Rubber Co., demonstrated a device for running compression set tests in the manner of D395-53T, Method B, which eliminates the use of shims, thereby simplifying this testing operation.

Subcommittee 17—Flexing Tests. B. S. Garvey, Jr., chairman. Dr. Garvey resigned as chairman of subcommittee 17 following this meeting and has been replaced by Howard Tangenberg, The B. F. Goodrich Co.

Dr. Stiehler reported that minor changes should be made in D430-51T, Methods of Dynamic Testing for Ply Separation and Cracking of Rubber Products, and D813-52T, Method of Test for Resistance of Vulcanized Rubber or Synthetic Elastomers to Crack Growth, to make them agree with ISO/TC 45 proposals. It was agreed to appoint a task group for this purpose.

Subcommittee 19—Tests for Properties of Rubber and Rubber-Like Materials in Liquids. W. N. Keen, chairman. In connection with a request from SAE-ASTM Technical Committee A it was agreed to add the following footnote to D471-55T, Methods of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids, Table 2: "Reference fuels Nos. 1 and 2 specified in D735-54T and D1170-54T are available

[1] India RUBBER WORLD, Oct., 1953, p. 61.

from Phillips Petroleum Co., Bartlesville, Okla."

It was reported that in the round-robin testing of two rubber compounds in ASTM oils Nos. 1 and 3 at 250, 275, and 300° F., only one of the five laboratories participating obtained widely divergent results. There was no significant difference shown between the results for the specimens aged in oil baths and those aged in aluminum blocks. It was reported further, however, that factors proving highly significant in connection with the high-temperature oil aging of nitrile rubber stocks, with special reference to tensile and elongation tests, were the effects of sulfur and the effect of the interaction of sulfur and water in the test tubes used to contain the samples during the aging period.

A task group will review a proposed method for using liquids at temperatures above their boiling point in oil aging of rubber stocks.

The ISO/TC 45 method of oil-immersion testing of rubber stocks will be reviewed and a report made at the next meeting in June.

Subcommittee 20—Adhesion Tests. H. H. Irvin, Marbon Chemical Division, Borg-Warner Corp., chairman. D413-49, Method of Test for Adhesion of Vulcanized Rubber (Friction Test) was reviewed, and it was decided that no revisions were necessary at this time. A comparison will be made between D413-39 and Federal Specification 601 on oil-immersion testing, and any suggestions for revisions necessary to obtain complete agreement between these two specifications will also be made in June.

As a result of correspondence between ISO/TC 45 and the chairman of subcommittee 20, it was suggested that ISO/TC 45 follow revised Method B of D429-47T, Method of Test for the Adhesion of Vulcanized Rubber, and the tentative revisions of Method A of D429-47T, both of which are very close to the ISO/TC 45 recommendations in principle.

In connection with test procedures that might be added to D429-47T, W. Frye, Inland Mfg. Division, General Motors Corp., agreed to keep subcommittee 20 informed on dynamic fatigue tests; Hugh Macey, Goodrich, agreed to keep the subcommittee informed on non-destructive tests for measuring adhesion of rubber to metal; and P. J. Larsen, Lord Mfg. Co., will assemble information on equipment for adhesion testing at elevated temperatures.

The revision of D429-47T, including changes approved at the meeting on March 1, 1956, will be submitted to letter-ballot in Committee D-11.

Subcommittee 22—Cellular Rubbers. H. G. Bimmerman, Du Pont, chairman. There was no meeting of this subcommittee, but numerous revisions in D1055-54T, Specifications and Methods of Test for Foam Rubbers, and D1056-54T, Specifications and Methods of Test for Sponge and Expanded Cellular Rubber Products, as outlined in a letter dated February 10, 1956, to A. W. Carpenter, D-11 secretary, by Mr. Bimmerman, were recommended for letter-ballot in Committee D-11.

Subcommittee 23—Hard Rubber. W. J. Dermody, Stokes Molded Products, chairman. It was decided to combine the activities of the asphalt and hard rubber sections of the subcommittee and eliminate the asphalt section, as such. The existing name for the subcommittee will remain as is.

A method for the determination of soluble iron in battery products will be letter-balloted in the subcommittee in advance of the June meeting and, if approved, will be submitted for letter-ballot in Committee D-11.

A modified Elmendorf tear test was discussed as a possible means for evaluating rubber and rubber-resin blend battery products, but it was decided to discontinue work on this test because of lack of correlation with field experience.

It was decided to develop a method for hardness testing of hard rubber and allied materials, using the Shore D durometer, for inclusion in D530-50T, Method of Testing Hard Rubber Products.

The work in Committee D-20 on Plastics on impact testing was reviewed, and a task group appointed to draft an impact test method adaptable to both test specimen and finished product testing which would eliminate or minimize the effect of "working" the specimen by repeated impact in existing falling weight tests.

A further revision of D530-50T to substitute a heat distortion test on unannealed specimens at 264 psi. fiber stress in accordance with D648-45T, Method of Test for Heat Distortion of Plastics, for the present softening point test in D530-50T, will be letter-balloted in the subcommittee.

Existing methods of hot-cold cycling tests for asphalt battery containers will be reviewed and a procedure developed for inclusion in D639-52T, Methods of Testing Asphalt Battery Containers.

The standard test temperatures in D1349-54T, Recommended Practice for Standard Test Temperatures for Rubber and Rubber-Like Materials, will replace the present test temperature conditions in D530-50T.

A discussion of difficulties encountered in attempting to comply with obsolete customer specifications highlighted the need for greater consumer participation in subcommittee 23.

Subcommittee 24—Coated Fabrics. K. L. Keene, United States Rubber Co., chairman. D751-52T, Method of Testing Rubber Coated Fabrics, was reviewed and found to need revisions because of changes in industry practices.

A report of a task group on adhesions was approved except for the section on jaw separation speed and method of reporting results, which were returned to the task group for further study. The entire report will be submitted again at the June meeting.

A questionnaire will be circulated within the subcommittee to determine the rate of displacement in machines used for testing hydrostatic resistance of coated fabrics (high-pressure method), and a report will be made at the June meeting also.

D815-47, Method of Test for Hydrogen Permeability of Rubber-Coated Fabrics, was reviewed, and it was decided that no changes in this method were required.

The use of the Du Pont scrub tester was again reviewed at the request of Northrop Aircraft Corp. because it is in some Aeronautical Materials Specifications. No action was taken because of the lack of correlation between tests made on different machines.

A new jig for conducting stitch-tear tests was exhibited, and a task group appointed to evaluate this apparatus.

Task groups will also be appointed for work on tests for cold cracking and flame resistance.

Subcommittee 25 — Low Temperature Tests. R. S. Havenhill, St. Joseph Lead Co., chairman. The negative vote in the Committee D-11 letter-ballot of February 1, 1956, on the revision of D832-46T, Recommended Practice for Conditioning for Low Temperature Testing, was resolved, and the method returned to the task group for the necessary editorial changes and additional changes proposed at the meeting on March 1. These additional changes include a change in the crystallization temperature of neoprene from 0 to —10° C., and the use of newer types of cold box insulation.

The chairman discussed the action taken on four ISO/TC 45 Draft Proposals on low-temperature testing at the ISO/TC 45 September, 1955, meeting. It was pointed out that the ISO committee was desirous of making the low-temperature hardness instrument (Materials Lab-Admiralty Indentometer—ML1 conform as nearly as possible with the room-temperature instrument (Wallace).

One of the two negative votes in the D-11 letter-ballot on the low-temperature hardness test (ML1) was resolved when it was shown that now at least five of these instruments are in use, and they are readily available from Mast Development Corp.

The other negative vote was resolved by agreement to hold up administrative action by the Society on the method pending investigation regarding conformity of the two instruments (ML1 and Wallace) as to size of indentometer, major and minor loads, and the use of the foot. A task group was appointed to investigate these matters.

It was pointed out by C. K. Chatten, Bureau of Ships, that the ISO Wallace instrument, owing to the location of the dial gage above the major load and spindle, has only 30 grams of force available to overcome friction from freezing when used in low temperature work. The ML1 provides positive dial gage action with the entire 1,000-gram major load acting through the dial gage. In addition, inaccuracies due to possible misalinement of dial gage and spindle are accentuated in the Wallace instrument because of flat-to-flat contact as contrasted with point-to-flat contact in the ML1 instrument.

I. Kahn, Army Ordnance Corps, presented information of a new method of determining the speed of the solenoid striking arm in D746-54T, Method of Test for Brittleness of Plastics and Elastomers by Impact, and indicated that further work was being done in order to compare this method with the French method.

Information on the ISO/TC 45 German proposal for low-frequency dynamic testing in which the low-temperature behavior of

stocks was based on several points on the temperature-stiffness and temperature-energy curves was presented by Ross Shearer, B. F. Goodrich Research Center, and W. N. Keen.

Subcommittee 26—Processibility Tests. Rollo H. Taylor, Scott Testers, Inc., chairman. It was decided to prepare a proposal for the use of the Mooney viscometer for the determination of the viscosity of rubber and rubber compounds for submission to ISO/TC 45.

D926-47T, Method of Test for Plasticity and Recovery of Rubber and Rubber-Like Materials by the Parallel Plate Plastometer, will be recommended to advancement to standard following the inclusion of certain changes in the units used.

A task group was appointed to investigate the possibility of obtaining a more stable rotor for use in the Mooney viscometer.

Subcommittee 28 — Statistical Quality Control. E. S. Bader, Goodrich, chairman. The revised "Proposed Tentative Recommended Practice for Planning Interlaboratory Testing" will be submitted for letter-ballot in Committee D-11.

The following problems are being worked on for other subcommittees of D-11:

1. Development of a sampling procedure to be used with the test for moisture content of GR-S type elastomers. (Subcommittee 13.)

2. Evaluation of round-robin test data obtained on immersion tests on packing materials. (Subcommittee 6.)

3. Design of experiment and evaluation of a program for isolating causes for irregular stress-strain results obtained with immersion tests. (Subcommittee 19.)

New problems presented to subcommittee 28 for future work consist of the following:

1. Evaluation of round-robin test data obtained from a comparison of Shore, Wallace, ASTM, and Rex hardness instruments. (Subcommittee 17.)

2. Review Committee D-11 standards and devise a standard system for determining the size or number of the samples that are to be taken in connection with the various test methods.

It was again pointed out by the chairman of subcommittee 28 that there was an urgent need of additional qualified personnel in order to continue the work of this subcommittee.

Subcommittee 29 — Compounding Ingredients. A. E. Juve, Goodrich Research Center, chairman. This new subcommittee had its first meeting on February 29. The most recent round-robin test designed to develop a set of test recipes for testing carbon blacks in rubber was reviewed. A similar round-robin test run earlier had indicated that the test recipes (two based on natural and one based on GR-S type rubber) were satisfactory except that at 50 parts loading of black certain of the blacks gave very short breaking elongations on the stress-strain test.

In the current round-robin test the effects of reducing the black loading to 45 and 40 parts were to be determined as well as the differences in results when mixing was done in a Banbury or on an open mill. A statistical analysis of the data from this round-robin test showed the extent of these differences, and it was decided that the black loading to be employed should be adjusted to the type of black as well as polymer and could vary from a minimum of 40 parts to higher values.

A task group will be appointed to study means of modifying the milling procedures (either mill or Banbury) used in connection with testing carbon blacks in rubber in order to bring them into closer agreement.

Another task group will be appointed to analyze the data obtained in the two round-robin test programs run on carbon blacks in rubber with the object of determining the feasibility of employing reference blacks for all comparisons as a means of cancelling out much of the laboratory-to-laboratory variations.

In connection with D15-54T, Sample Preparation for Physical Testing of Rubber Products, numerous modifications are necessary as a result of recent developments. A task group is to be appointed to study these modifications and to recommend the necessary changes.

A new standard reference material has been added by the National Bureau of Standards. It is an SRF carbon black supplied through the courtesy of United Carbon Co.

SAE-ASTM Technical Committee A

A report on the activities of the SAE-ASTM Technical Committee on Automotive Rubber was presented by J. J. Allen, secretary of that committee. Since the July, 1955, meeting, Tech A held two regular meetings, one on September 14 and the other on December 9.

Letter ballots in Tech A approved five revisions of D735-54T, Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications, as follows:

(1) Change in title to read: "Specifications for Elastomeric Compounds for Automotive Applications."

(2) Change in wording of the scope in line with the change in the title of D735-54T.

(3) Deletion of paragraphs a and b in Section 5 of D735 and combining them with paragraph 1 to read: "Test results from finished products may not duplicate the values from standard test specimens."

(4) Addition of asterisks in the tables of compounds in D735 to indicate the most commonly used grades.

These revisions have since been approved by Committee D-11 and will appear in the new printing of the "ASTM Standards on Rubber Products," of D-11.

Letter-ballots approved changes in the burst pressure of SAE 100 R1 and R2 Hydraulic Hose Specifications. These changes have been held up by the SAE Tube, Pipe, Hose and Fittings Committee, however, for further consideration.

Letter-ballots approved a change in the outside diameter of standard 5/8-inch ID air brake hose in SAE 40 R2 to bring the specifications for this hose in line with commercial practice.

Subsection IV-H has organized task group A jointly with subcommittee 19 of D-11 to study the problem of obtaining constant results in fluid immersion tests at temperatures above 250° F.

Subsection IV-L is conducting a round-robin test to compare ASTM D736-54T, Method of Test for Low-Temperature Brittleness of Rubber and Rubber-Like Materials, with D746-54T, Method of Test for Brittleness Temperature of Plastics and Elastomers by Impact. This test is considered necessary before D746 can be approved as the official method for incorporation in D735.

Sections X, Gaskets; XI, Oil Seals; and XI-A, O-Rings, have been combined into Section X, Automotive Oil Seals and Gaskets. The work of Section X is now divided as follows: subsection X-A, O-Rings; subsection X-B, Radial Oil Seals; and subsection X-C, Non-Metallic Gaskets.

A request has been made of ASTM Committee D-11 that a footnote be added to D471-54T, advising that reference fuels Nos. 1 and 2 are now available from the Phillips Petroleum Co., since they are required for use in D1170-54T. The gasket committee has not approved the use of reference fuels A and B, but is evaluating them in comparison with fuels Nos. 1 and 2 in connection with the complete revision of D1170.

ISO/TC 45 on Rubber

R. S. Havenhill, W. A. Ross, R. F. Shaw, and R. D. Stiehler represented the United States at the sixth meeting of ISO/TC 45 in Dusseldorf, Germany, during the week of September 5-10, 1955. Amendments were made to the sixth-draft ISO Recommendations submitted to the member nations during the previous year. The United States has given final approval to the ISO Recommendations, as amended, for tests for tear strength, hardness, and the mechanical stability of latex. Approval, subject to minor modifications, was given to the ISO Recommendations for rubber-fabric adhesion and tensile stress-strain testing.

The following proposals were approved for submission as Draft ISO Recommendations: sampling of latex, flex cracking, cut growth, aging, and aging in cell-type ovens. In addition, the following proposals were approved subject to postal approval of revised drafts: copper, manganese, dirt in raw rubber, and low-temperature brittleness testing.

Substantial progress was made in reaching agreement on several other proposed methods, including standard test conditions. Several requests were received for specifications of rubber products. The secretariat has tabled these requests, temporarily, since ISO/TC 45 has not progressed sufficiently far on methods of test of this type. It was agreed, however, to discuss the question of product specifications at the next meeting.

Countries represented at the Dusseldorf meeting included Australia, Austria, Belgium, France, Germany, Italy, Netherlands, Poland, Spain, Sweden, Switzerland, United Kingdom, the United States, and U.S.S.R.

The seventh meeting of ISO/TC 45 is scheduled to be held in Zurich, Switzerland, during September, 1957.

ASTM Technical Committee D-24 on Carbon Black Formed; Specifications, Tests, Nomenclature in Scope

A meeting for organization of a new technical committee on carbon black of the American Society for Testing Materials was held February 29 during ASTM Committee Week in Buffalo, N. Y. At a conference held June 30, 1955, during the ASTM annual meeting in Atlantic City, N. J., attended by 20 members of the Carbon Black Industry Analytical Committee (CBIAC), members and ASTM officers, staff and committee representatives, it was agreed that this new committee on carbon black should be formed. At its September 20, 1955, meeting the ASTM board of directors approved the recommendation and appointed R. C. Alden, of Phillips Petroleum Co. and an ASTM director, chairman of a steering committee to arrange for the organization of the committee.

At the Buffalo meeting R. E. Hess, technical secretary of the Society, welcomed those present and explained the authorization of the committee by ASTM. He added that A. G. Cobbe, Columbian Carbon Co., had been designated temporary secretary until such time as permanent officers of the committee are elected. Since carbon black is used with a number of materials considered by other committees of the Society, it will be necessary for the D-24 Committee to work closely with those ASTM committees.

C. A. Carlton, J. M. Huber Corp., chairman of CBIAC, which provided the impetus for organizing the new ASTM committee on carbon black, stated that over the last year and a half, representatives of several carbon black producers had been working to systematize test methods for carbon black and had progressed to the point where the industry was ready to propose these methods for consideration by ASTM. The new D-24 Committee will provide the necessary producer-consumer-general interest representation to consider the test methods developed by the carbon black producers. There are 13 test methods considered adequately developed for immediate consideration.

Scope of D-24

After some discussion the following statement of scope was approved by those present at the organization meeting:

"The promotion of knowledge of the properties of those materials generally known as carbon blacks, including stimulation of research and the development of methods of test, classification, specifications, and nomenclature. These activities will be coordinated with those of relevant committees of ASTM."

Other ASTM committees mentioned in regard to coordination were Committees D-1 on Paint, Varnish, Lacquer and Related Products; D-11 on Rubber and Rubber Like Materials; and D-20 on Plastics. It was pointed out that the scope of an ASTM committee defines the area in which a committee *can* work, but it is not required that the committee carry out all of the activities which may be included in the scope; it is permissive rather than mandatory.

Chairman Alden pointed out that the scope, as approved by the group, would be submitted to the ASTM directors for approval. Other recommendations concerning program, officers, committee structure, etc. would be in the form of recommendations to the committee for consideration at its organization meeting.

Organization

The following subcommittees will be recommended as the original structure of D-24: (1) Physical Tests; (2) Chemical Tests; (3) Optical Tests; (4) Sampling; (5) Nomenclature and Definitions; (6) Coordination with Other Committees.

Two other subcommittees were suggested for further consideration, these being Weights and Measures, and Editorial. It was decided that D-24 would not work on reference materials. It was decided also to leave the specific organization of the advisory committee up to D-24, but that the advisory committee should be balanced with regard to producer, consumer, and general-interest members, and there should be a maximum limit placed on the number of members.

Officers, Membership, Etc.

Chairman Alden was authorized to appoint a nominating committee for the selection of candidates for officers of D-24. He announced a nomination committee to be headed by A. E. Juve, B. F. Goodrich Co. Research Center; with J. F. Svetlik, Phillips Petroleum; C. E. Carlson, General Tire & Rubber Co.; and R. G. Seaman, RUBBER WORLD; as the other members.

It was announced that those who attended the February 29 meeting for organization of D-24, as well as those who were unable to attend, but expressed a desire to participate would be included on the preliminary membership list to be referred to the ASTM directorate for approval. Mr. Hess suggested that present members also provide the names of additional individuals interested in taking part in the work of the new committee.

Alden and Cobbe will prepare a draft of by-laws which will outline procedures to be followed by the committee supplementary to the Society's Regulations Governing Technical Committees, for consideration by D-24 at its next meeting during the week of June 18 in Atlantic City.

Proposed Test Methods

Publication of the 13 test methods developed by CBIAC, as information, probably in the *ASTM Bulletin*, has been approved. Mr. Hess emphasized that these test methods will have no official ASTM status, but will be published as information to solicit comment for the benefit of the committee. Any methods developed by D-24 will have to go through the necessary committee ballot and regular procedures of the Society before adoption.

A representative of the CBIAC stated that considerable data on the reproducibility and value of the 13 industry test methods had been accumulated, and it was decided that these data be furnished to members of D-24 for their information.

The 13 CBIAC test methods follow: (1) Pellet Size Distribution of Carbon Black; (2) Solvent Extractable Material in Carbon Black; (3) Screen Residue; (4) Attrition of Pelleted Carbon Black; (5) Discoloration of Benzene by Carbon Black; (6) Iodine Number; (7) Amount of Fines in Pelleted Carbon Black; (8) Heating Loss; (9) Pour Density of Pelleted Carbon Black; (10) Volatile Content; (11) pH; (12) Ash; (13) Mass Strength of Pelleted Carbon Black.

Program for Design Engineering Conference

The scheduled program for the forthcoming Design Engineering Conference, to be held at Convention Hall, Philadelphia, Pa., May 14-17, under the sponsorship of the machine design division of the American Society of Mechanical Engineers, has been revealed by Clapp & Poliak, Inc., New York, N. Y., producer of the Design Engineers Show, which will be held concurrently with the Conference.

Nine authorities in the field have been selected to lead the four-day discussion period. Topics under scrutiny will include cost reduction in product design, procurement and training of design engineers, engineering materials for products, miniaturization, recognition for invention, and legal rights to inventions.

The program follows:

May 14: "Value Analysis in Product Design." A. D. Bentley and W. L. Healy, General Electric Co.

May 15: "How to Get and Train Design Engineers." Chester Linsky, Pennsylvania State University; A. A. Johnson, Westinghouse Electric Corp.; and Bernard J. Covner, Dunlap & Associates.

May 16: "Selecting Engineering Materials for Products." W. A. Irvine, Maytag Co. Also **"Problems in Miniaturization."** William C. Schmidt, Bell Telephone Laboratories, Inc.

May 17: "Recognition and Reward for Invention." W. A. Steiger, Westinghouse Electric Corp. Also **"Rights of the Employes' Inventions."** George V. Woodling, patent attorney.

Plastic Wall Tile Booming

About 200 million square feet of plastic wall tile will be bought for residential use in 1960, it was reported at a meeting of the industry's representatives at Cleveland, O., March 6. The meeting was sponsored by the plastics division of Monsanto Chemical Co., Springfield, Mass.

The prediction represents a 50% increase over 1954 sales. It was based on a market and consumer survey conducted by Dun & Bradstreet. The report cautioned, however, that such an increase will take place only if improved design and workmanship are coupled with more effective marketing.

Three Papers on Rubber-to-Metal Bonding Presented at Symposium of Chicago Group

"Rubber-to-Metal Bonding" was the subject of a symposium given before the Chicago Rubber Group at the Furniture Club, Chicago, Ill., February 17, with three technical papers being presented to the 300 members and guests in attendance and a question-and-answer period following. Reed Williams, Dryden Rubber Division, Sheller Mfg. Co., was the moderator.

Panelists and the titles of their papers follow: Fred W. Gage, Dayton Chemical Products Laboratories, "A Theory of Bonding", Howard H. Irvin, Marbon Chemical Division of Borg Warner Corp., "Testing Method"; and William F. Abbey, R. T. Vanderbilt Co., "Preparation of Metal and Application of Adhesive."

Group Chairman Larry Heide, Acadia Synthetic Products Division, Western Felt Works, announced the appointment of John Groot, Dryden Rubber, as chairman of the annual golf outing. The O'Connor Laminar Oyster Bar, available through the courtesy of Maurice O'Connor and Laminar Corp., was open before dinner.

Reed Williams

A Theory of Bonding—*Intrinsic Adhesion*

By Fred W. Gage

Dayton Chemical Products Laboratories, Inc.

I would like to introduce a bonding concept that has aroused interest among a number of persons in the rubber-to-metal bonding field and has been helpful in many cases in adhesion development, evaluation, and research planning in our own laboratories. This is the concept of *intrinsic adhesion*. Although, so far as we know, the use of this concept in our laboratories is novel, no originality is necessarily claimed since the concept, as I will outline it, involves simply a statement of factors which have always been present and observable.

Types of Bonds

Webster defines the word *intrinsic* as "pertaining to that which is real or genuine." Now in the development of the bond between rubber or rubber-like materials and a metal surface, the strength or quality of the bond, as measured by most methods, is more often than not deceptive. If the strength of the bond is less than that of the strength or tear resistance of the rubber stock, a reasonably true value of the bond strength can be obtained. The bond may fail at the metal-to-cement interface, usually referred to as "metal failure," or it may fail at the cement-to-stock interface, usually referred to as "cement failure."

Fred W. Gage

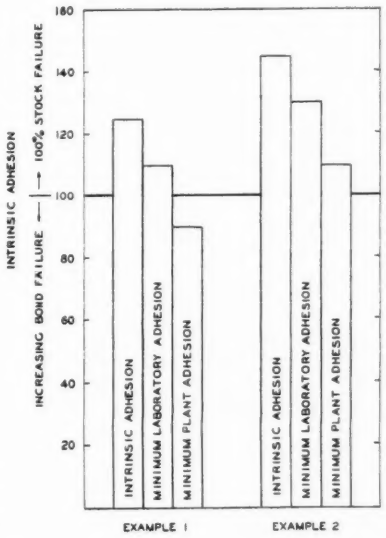

Fig. 1. Examples of relation between *intrinsic adhesion* values and laboratory and factory adhesion values

In any event the numerical value obtained reflects in a general way the strength of the bond. If the bond is good, however, or if the stock has a low order of strength or tear resistance, the rubber stock itself will rupture, giving a false "adhesion" value. In this case the numerical value obtained is more a function of the stock than of the bonding system. These are the so-called 100% stock failure bonds, and it is with these bonds that we are here primarily concerned.

In the laboratory we may develop a cement system which gives 100% stock failure in test after test. These results may also be obtained in production trials in which laboratory supervision is maintained. Yet in run-of-the-mill production practice a certain amount of sub-standard bonding may result, which displays itself in cement or metal failure. Here is where our concept of *intrinsic adhesion* can be used to explain these observations.

Rating System

Let us assume a hypothetical scale in which 100 represents 100% stock failure, after making an ideal bond with the system at hand; and, for example, 75 represents 75% stock failure under similar ideal conditions (the other 25% is metal and/or cement failure). Then a bonding system which produces 100% stock failure in repeated laboratory tests can be assumed to have an *intrinsic adhesion* in excess of 100 on the hypothetical scale. For the purpose of illustration, let us assume that our bonding system has an *intrinsic adhesion* of 125.

In the laboratory this rating system will be subjected to the deleterious effects of numerous variables, since I do not know of any phase of testing that is more plagued with pitfalls than is the evaluation of a rubber part. However, if in our bonding system these factors at their statistical worst add up to a 15% reduction in bond, there will still be enough residual adhesion, in this case 110 on our hypothetical scale, to give 100% stock failure.

In production, on the other hand, the number of variables is increased manifold, or so it usually seems, over the number encountered in the laboratory. The introduction of other variables will bring about an even wider deviation from the *intrinsic adhesion*, and at its statistical worst, this deviation, we will assume, might be as much as 35%. In this instance, the residual adhesion will be 90. This will result in 10% metal and/or cement failure, and, in quality bonded parts, a certain amount of scrap rejection. This case is illustrated in Example 1 of Figure 1.

As another example, let us assume that

we have a bonding system with *intrinsic adhesion* of 145, and that the laboratory and plant are subjected to the same variables used in the first example. In this case the lowest observed adhesion value in both laboratory testing and plant practice will be in excess of 100, and only 100% stock failures will be observed, with no scrap losses such as were noted in the first example. This case is illustrated in Example 2 of Figure 1.

A further example of the application of this concept might be the bonding system which performs perfectly, giving 100% stock failure with a certain stock and a certain production part. However, when this same bonding system is applied to a different stock, or to the same stock, but a different metal part, adhesion shortcomings start to appear, and metal and/or cement failure is observed. If we can now find a bonding system possessing a greater *intrinsic adhesion*, we may be able to correct this situation.

Adhesive Development

Now, how can this concept of *intrinsic adhesion* be used to develop new and more efficient bonding agents? Since a good bonding agent is one which yields nothing but stock failure and is one whose *intrinsic adhesion* cannot be measured directly, indirect means must be employed to determine the relative quality of the better bonding systems.

One means of doing this is to collect a number of stocks of one polymer system that cannot be bonded by currently available bonding systems. All new bonding agents that are being developed for this polymeric system are then evaluated with these stocks. As soon as a bonding system is found which proves to have a high *intrinsic adhesion* in a standard laboratory test by giving 100% stock failure with a number of these difficult-to-bond stocks, it is subjected to exaggerated variations of the type invariably encountered in production.

Tests are run with thick and thin coats, long and short cures using a wide variety of temperatures, metal surfaces prepared in a number of different ways, test bars that have been exposed to different atmospheric conditions, thick and thin sections of stock, different metals, test bars that have been smudged with fingerprints, just to mention a few. When a cement repeatedly gives 100% stock failure in most or all of these tests, it is assumed to have a high *intrinsic adhesion* and is ready to be released for field testing.

Usually a new cement of this type, when submitted to the field, is soon applied to a stock with which results are less than 100% stock failure. This stock is then added to the other hard-to-bond compounds and development work continued.

Naturally, as new demands are made on bonded rubber parts by the automotive and airplane manufacturers, stocks that are increasingly difficult to bond are continually being developed. Stocks of this type are a constant challenge to work out bonding systems of higher and higher *intrinsic adhesion*.

Conclusions

The result of this type of attack has been the development of bonding systems which have eliminated scrap in the factory on some jobs, reduced it substantially on others, and, in still other cases, has made it possible to bond on a production basis stocks which have not previously been regarded as suitable for bonding work, despite other properties which were regarded as advantageous.

As is apparent, we have found the concept of *intrinsic adhesion* very useful in our development work. We hope it may prove of some use to you in solving your bonding problems.

Testing Methods

By Howard H. Irvin

Marbon Chemical Division, Borg-Warner Corp.

The determination of the quality of rubber-to-metal bonds is a most difficult task since up to now all established test methods have depended on the destruction of the bonded assembly for determining bond quality with 100% accuracy. Since it is obviously impossible to test all assemblies in this fashion in the factory, extreme care must be taken in production operations so that on the basis of a few tests on assemblies taken at random from the production line a reasonably accurate picture of bond quality can be obtained.

Metal Surface Control

When we talk about testing, therefore, we should realize that testing includes close control over all phases of the bonding operation. Starting with the metal, it is essential to control metal composition as well as the operations necessary to produce the metal shape in its final form. This must be followed by careful control of metal preparation for bonding. In the case of grit or shot blasting, grit type and size should be carefully controlled, and it should be checked from time to time for contamination by greases, oils, and other foreign matter.

Howard H. Irvin

Where metal is descaled or cleaned by chemical methods, it is important to control concentration and temperature of the cleaning bath as well as time of immersion of the metal parts. A control test for the cleanliness of the metal surface to which an adhesive is to be applied is very essential. Observing the readiness with which a drop of water will spread on a clean metal surface is a simple and effective check in most instances.

Adhesive Control

In the case of the adhesive, manufacturers' instructions for storage as well as use should be followed meticulously. Uniformity of the adhesive should be controlled by agitation if necessary, particularly before smaller quantities are withdrawn from a larger volume of supply. Viscosity control of the adhesive is important in the factory, since variations in viscosity, caused by evaporation of solvent during use, will affect the thickness of the coat applied to the metal part, and this in turn may have considerable bearing on the bond strength obtained.

A Ford cup or a Brookfield viscosimeter are instruments that are readily adapted for viscosity checks on the production line. No universal recommendations for the optimum thickness of the applied adhesive coat can be made since this will depend not only on the method of application, but also on the surface topography of the metal part.

Stock Control

The rubber compounder usually has very rigid specifications for the physical properties of the rubber stock to be bonded. He has, however, considerable leeway in choosing compounding ingredients to achieve these physical properties by keeping oils, waxes, and plasticizers to a minimum as well as by proper adjustment of cure rates.

Careful control should be kept over the compounding procedures for plant-size batches, and these procedures should not be deviated from once they have been established unless changes have been carefully evaluated. The same holds true for curing conditions, once they have been established.

Test Methods

The test methods most widely in use in this country for evaluating bond quality on a laboratory scale and for the subsequent checking of completed plant assemblies depend largely on ASTM[1] test method D429 or modifications thereof.

Method A of D429 is a tension test, where a rubber sandwich bonded between two parallel metal plates is subjected to a tensile force until the assembly fails. Adhesion is then rated by the pounds per square inch force required to break the assembly and by the type of failure that is obtained. This test, which has been in use for many years, is currently under review by an ASTM subcommittee, particular at-

[1] American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

tention being given to the optimum diameter for the test piece as well as the optimum thickness for the rubber inter-layer.

Method B of D429[2] covers a strip test which was revised in 1955 for ready use by any laboratory equipped with a rubber tensile testing machine. This test depends on the stripping of a rubber strip which has been bonded over a one-square-inch area to a metal surface; the stripping force is applied at an angle of 90 degrees. In this test the stripping force as well as the type of failure is recorded. This procedure is particularly well suited for laboratory work and, since its adoption by ASTM, has found wide acceptance in the industry.

Subcommittee XX of ASTM committee D-11 on rubber has not only been active in the reevaluation of these current test methods, but is also concerned with the development of other methods that would be useful to the industry. This includes testing bond strength at elevated temperatures, under dynamic conditions, and, of course, the hope of developing non-destructive test methods.

Summary and Conclusions

The criterion by which rubber-to-metal adhesion is generally judged by industry today is whether or not failure occurs in the rubber stock. If 100% rubber failure occurs during a test, the bond is rated satisfactory. This is actually an admission that available adhesives withstand test conditions better than the stocks which they bond.

It was emphasized at the conclusion of these comments on testing that the bond strength should never be tested immediately after the conclusion of the curing operation. Each assembly should be given at least up to 16 hours rest, during which time it can achieve equilibrium, before any test operations are conducted. This practice, of course, is not always possible in plant operations, but the rest period is absolutely essential where the metal part goes through a forming operation subsequent to the curing step.

[2] RUBBER WORLD, Apr., 1955, p. 55.

Preparation of Metal and Application of Adhesive

By William F. Abbey
R. T. Vanderbilt Co.

There are many applications where an elastomer is bonded to metal or other rigid material in the product being manufactured, and the strength with which the surfaces adhere is an important factor in determining the usefulness of the article in service. Rubber-to-metal assemblies of this type are frequently used to dampen sound, shock, and vibration or to reduce friction.

Typical industrial applications in the automotive field include motor mounts, shock absorbers, fender guards, and vibration dampers. Rubber-to-metal traction members, such as solid tired driving or bogie wheels and tread blocks for tanks or tractors, also depend on the strength of the bond for serviceability. Printing or other industrial rolls, tank linings, tire beads, and insulation-to-conductor adhesion, as required in certain wire and cable structures, are other possible applications that require permanent bonds between rubber and metal.

Bonding Methods

There are three possible approaches to obtaining a rubber-to-metal bond:

(1) The use of halogenated elastomeric derivatives.

(2) The use of various polymeric resins such as vinyl pyridine, urea-formaldehyde, phenol-formaldehyde, or isocyanates. Materials in this class are mainly used for specific applications, such as bonds requiring high solvent resistance or for sustained use at extremely high temperatures. They also find applications in bonding rubbers to natural and synthetic fibers in tires and some belting and hose structures.

(3) The application of a brass plate to the metal part, generally steel, to provide a surface upon which specially compounded

William F. Abbey

rubbers will adhere during vulcanization. This method requires expensive equipment and close chemical control of the plating operation to obtain good results consistently.

Recently the trend has been toward the use of specially compounded cover cements both in conjunction with adhesive prime coats and with brass plate. These are used to obtain maximum adhesion and consistent results. They prevent the contamination and oxidation of the coated or plated metal surface. They permit wider latitude in compounding and make possible bonds with stocks containing ultra-accelerators, waxes, and heat-resistant compounds of low sulfur types.

Preparation of Metals

Steel, the most widely used metal in rubber bonded assemblies, can be prepared for use by the following procedure:

1. Degreasing. This is done by either vapor phase cleaning with ethylene trichloride, or by detergent treatment, such as trisodium phosphate.

2. Removing scale or rust. This can be done by grit blasting with steel, carborundum, or sand, or by pickling which should be followed by neutralization with an alkaline solution, rinsing and drying.

For most applications, 80-mesh SAE steel grit is satisfactory. Coarser grits may be used for removal of heavy rust deposits. If one is working with very coarse grits, bond strength can generally be improved by the use of cover cements. The optimum surface for adhesion to steel using these halogenated adhesives is a mirror finish.

For best results with magnesium or Dow metal, it is recommended that a chromate pickle be used. Follow this with ample washing in cold, then hot water. Dry the parts thoroughly. The chromate bath is prepared according to the following formula:

Sodium dichromate	1.5 pounds
Concentrated HNO_3 (Sp. gr. 1.42)	1.5 pints
Water to make	1.0 gallon

Dip for 1-2 minutes into the bath kept at room temperature. If additional adhesion is required, the parts can be heated for periods up to 16 hours at 400° F. We have found that this heat treatment improves adhesion strength.

For aluminum, we recommend a dip of 1-2 minutes in a 5-10% solution of sodium carbonate at 200° F. Follow this with neutralization in dilute nitric acid. Wash thoroughly in water and dry. Another method is by anodizing the aluminum in an electrolytic bath containing chromic or sulfuric acid. These methods produce a tough, adherent film of aluminum oxide on the surface which aids in adhesion.

For zinc and galvanized iron we recommend an immersion into a 15% phosphoric acid solution at 150° F. The parts should be dipped for 1-2 minutes. They should then be washed in cold water, then in hot water, then dried thoroughly.

Good adhesion of GR-S type rubber, natural rubber, and neoprene has been obtained to Amaloy (80 Pb-20 Sn), black iron, cadmium plate with halogenated adhesives. No special treatment has been required for Amaloy other than degreasing. For black iron, degreasing and grit blasting have been found to be sufficient. Since commercial cadmium plate thicknesses run only to about 0.0002-inch, for best results we recommend that, following degreasing, cadmium plated parts be heat treated for periods up to 16 hours at 400° F.

Fair adhesion of neoprene to copper and Monel metal has been obtained. The results with GR-S type rubber and natural rubber have been generally poor with these metals.

For adhesion to solid brass, brass plate, and bronze, we recommend the use of cover cements directly on the metal. The halogenated elastomeric adhesives do not adhere too well to these metal surfaces.

For solid brass, we recommend that conventional degreasing and grit blasting be tried as a first treatment. If additional adhesion is required, an immersion into an acid solution prepared as follows has been used with success:

Concentrated HNO_3	100 cc.
Concentrated H_2SO_4	100 cc.
Zinc oxide	8 grams

Follow this with washing in cold water, then in hot water, then dry thoroughly. Apply a coat of the cover cement designed for the elastomer used in the compound to be bonded.

For brass plate, no additional surface treatment is usually needed unless the parts have been stored for some time. In that event an immersion into a dilute alkali, followed by an immersion into a 15% solution of phosphoric acid, followed by washing and drying will prove successful. Apply a coat of the cover cement designed for the elastomer to be bonded.

For bronze, we recommend the use of the dilute alkali-phosphoric acid treatment mentioned for brass plate. We think it advisable to use it on all bronze parts, no matter how long they have been stored.

Application of Adhesive

When the adhesive is used in factory work, it is advisable to stir the adhesive thoroughly, prior to application, each time some of the material is drawn off. Since most rubber-to-metal adhesives are multiphase systems, this frequent stirring should be enforced to assure absolute uniformity.

In applying the adhesive to metal, one uniform coat of the adhesive is sufficient. It may be applied by brushing, dipping, or spraying. If the adhesive is applied by brushing, the applicator should be washed frequently in xylol. The adhesive applied by this method should be used full strength.

For spraying, it is common practice to dilute primer adhesives with xylol (10° coal tar) or toluol, preferably with xylol. Sixty adhesive/40 solvent by volume is a satisfactory dilution ratio for spraying. Spraying equipment used for these adhesives should be made only of steel, stainless steel, or nickel. Compressed air lines must be kept free from moisture and oil.

For dipping, a 50% dilution by volume of these adhesives with solvent provides a satisfactory working consistency. The shape and dimensions of the metal part, as well as the drying conditions, may, however, require a different ratio of adhesive to solvent.

The object in applying adhesive by any of these methods is to obtain a thin, uniform coverage of the metal part. Metal parts for motor mounts and similar articles may be covered completely with the bonding agent. This covering will prevent rusting of the exposed metal surface.

It is essential that adhesive-coated metal parts be allowed sufficient drying time before direct bonding or the application of cover cement. Drying time can, in some cases, be shortened by preheating the metal part (about temperature 150° F.). While excessive drying temperatures should be avoided, drying under controlled heat (up to 212° F.) will prevent the condensation of moisture from humid air on the prepared surface.

Cover cements for rubber and GR-S type rubber or neoprene should be applied to all adhesive-coated parts to be stored in excess of eight hours. These cements may be applied full strength by brushing, or diluted in a ratio of 60 cement/40 solvent for dipping or spraying. Aliphatic solvents (Solvasol[3] No. 3 or No. 4) are satisfactory diluents for these cover cements for rubber or GR-S. Troluoil[4] is the recommended diluent when one is working with cover cement for neoprene. Troluoil is a mixture of aliphatic solvents.

A clean fresh surface, free from dirt or bloom, is preferred in successful rubber-to-metal bonding. If the compound cannot be freshly sheeted or extruded before assembly, the surface contacting the prepared metal should be wiped lightly with toluol or xylol. The use of cover cements minimizes precautions necessary to obtain good results. In compression molding, the compound should be firmly pressed in contact with the coated metal as the cavity is loaded.

Maximum bond strength is obtained by vulcanization under pressure in a compression, injection, or transfer mold. The adhesive bonding system can, however, be used to produce satisfactory results in open-steam cures such as used to vulcanize rubber covered rolls and tank linings and is satisfactory for hot water cures. For best results, vulcanization temperatures should not exceed 350° F.

Question and Answers

Q. What is the effect of the modulus of cured rubber on bonding troubles?

A. Abbey. High-modulus stocks bond very well. Low-modulus stocks sometimes give trouble because of necking.

Q. Is there an explanation for the wide variation in adhesion of rubber to metal which is noticeable with different metals?

A. Irwin. Yes. The difference is in the condition of the surface of the various metals. Different metals form oxides and sulfides to a different degree, and different valence forces are present on the surfaces of different metals.

Q. What methods are used to bond natural rubber, GR-S type, or nitrile type rubbers to zinc chromate-plated metal surfaces?

A. Gage. Several commercial adhesives are available that give satisfactory performances. Some of these involve the use of special primers.

Q. What surface treatment is recommended to minimize washing away during transfer molding?

A. Abbey. A good method is to bake the surface. Also use a good cover cement.

Q. What is the best method for force drying of adhesives? What is the maximum temperature desirable?

A. Abbey. Adhesives can be dried by infrared rays or by warm air in continuous motion. The temperature should not be too high, or oxidation will take place. It should range from room temperature to a maximum of 200° F. If the metal is preheated above 100° F., the adhesive should also be heated before application.

Q. Will 2% of a low molecular weight polyethylene be harmful to adhesion of rubber to metal?

A. Irvin. Probably not. We have no experience with this polyethylene.

Q. What progress has been made in bonding polyacrylates to metal?

A. Gage. Very successful systems are commercially available, and experimental work is under way on special polymers of the acrylate type.

Q. With natural rubber stock containing FEF carbon black, does an increase in sulfur over three parts cause an increase in adhesion?

A. Irvin. It could, but there would be danger of causing greater deterioration in the rubber.

Q. Would an iron phosphate coating be advantageous on metal that varies in analysis?

A. Abbey. It usually improves the bond.

Q. How can you prevent wiping of cements during molding?

A. Gage. This is a matter of technique. Satisfactory primer cements are available. But the best way is a prebake, which will adequately prevent wiping.

Q. Is sand blasting recommended for cleaning metal for rubber bonding?

A. Abbey. No. Sand may embed in the metal and interfere with adhesion. Shot or grit blasting is recommended. It is important to get a mirror finish for best adhesion.

Q. With wire traveling at 500 feet per minute, can an adhesive dry fast enough in three seconds to permit bonding of rubber to wire?

A. Gage. Probably not, if the adhesive is cold. If the adhesive is warm, yes.

Q. What is the effect of humidity on bonding of rubber to metal?

A. Abbey. Humidity has no effect if there is no condensation on the surface of the metal or stock.

Q. Do you recommend threading a metal shaft for adhesion of rubber to it?

A. Abbey. Threading is not necessary when an adhesive is used. The best procedure is to be sure the shaft is clean. A mirror finish should be obtained.

Q. What are recommended procedures for bonding of silicone rubber to metal?

A.[5] It is important to stay away from organic materials when silicone rubbers are used. The surface should be as clean as possible, and a mirror finish should be obtained. As a tie gum, a low durometer silicone rubber stock with high physical properties should be used. The cure may be 10 minutes at 250 to 300° C., with a postcure of 25 minutes at 400° C. If high temperature service is not needed, it is not necessary to use the tie gum.

In cleaning by grit blasting, a source of trouble may be in oil from the air compressor. The parts should be completely clean, preferably by a degreasing operation, and completely dry. Very good bonding can be obtained by these methods, and all observed failures will be in the rubber, not in the bonds.

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[3] Socony Vacuum Oil Co., New York, N. Y.

[4] Anderson-Prichard Oil Corp., Oklahoma City, Okla.

[5] Answered by Douglas B. Moore, Dow Corning Corp., and M. C. Lauenstein, General Electric Co.

SAE Symposium Treats of Materials for Car Bodies; Six Papers Relate to Rubber and Plastics Applications

Six papers pertaining to rubber and plastics applications in the automotive field were presented at the Society of Automotive Engineers' Car Body & Materials Meeting at the Hotel Statler, Detroit, Mich., March 6-8. These are abstracted below.

"New High-Speed Tires." M. P. Hershey, Firestone Tire & Rubber Co.

The increasing top speeds of cars, higher tire loads, and improved highway conditions have brought about a need of new high-speed tires. One important consideration is that of tire size, since for a given speed the larger the tire the less revolutions per mile and the cooler the tire temperature.

Another critical item in high-speed performance is inflation pressure. Higher-than-normal pressure is desirable for sustained high speeds. Tire manufacturers now recommend increasing pressures by 4-6 pounds for sustained speeds above 85 mph. This increase compensates somewhat for overloading as well.

Tread and cord body compounds should be developed with low heat generation in mind, and high adhesion is necessary to prevent separation of the tread from the cord body and separation between plies. The tread pattern and cord body construction should be designed to minimize the tread wave motion which tends to develop at high speeds.

Firestone's new "500" and "Super Sports 170" tires meet the requirements of the high-speed era. The first is of four-ply nylon cord construction which makes for a tire that is cooler running. This tire is made with the original-equipment tread design which provides excellent traction, good squeal resistance, and good ride.

The second tire is made with a racing-type six-ply nylon cord body. The compounds used in the cord body give excellent adhesion between plies and between tread and body, as well as give low heat generation. The tread pattern has an aggressive design which gives good traction on both wet and dry surfaces. Tread wave motion is minimized.

"Some Aspects of High Speed Tire Testing." E. F. Powell, Dunlop Rubber Co., Ltd., London, England.

Indoor testing on drums forms a major part of English high-speed proving technique. Most of the machine testing is done on a smooth steel drum with an electrical drive having very flexible speed range. Any chosen speed can be held steady to within 1%, and a torsion dynamometer is included in the drive for measurements of tire power consumption.

So-called traction wave is an important factor to be tested. A camera mounted in exact alinement with the contact area is set to include the face of the tachometer and a standard scale for subsequent enlargements of the prints. By a rapidly accelerating run of about 30 seconds' duration, with a photograph taken every two seconds, a photo series becomes available.

The tire is subsequently tested on a car in actual road conditions. Temperatures of the tires are measured as quickly as possible at the end of each run. For aircraft tires, the full indoor evaluation is essential before preliminary trials, since the consequences of failure are too serious.

"Seals for Passenger-Car Automatic Transmissions." R. C. Grasby, Chicago Rawhide Mfg. Co.

Seals for passenger-car automatic transmissions fall into two groups: spring loaded oil seals for rotating shafts, and synthetic rubber cup packings for actuating clutches. The first type is used at the front and the rear of the automatic transmissions.

Nitrile rubber is used for front oil seals to handle a maximum temperature of 250° F. Silicone rubber, polyacrylate rubber, butyl-acrylate rubber, and Teflon[1] have recently been used for this application, with good advantage, although their cost is higher. For rear oil seals, nitrile rubber is probably still the best material, since the seals have to contend with lower rubbing speeds.

Synthetic rubber cup packings for actuating clutches are the so-called piston packings or lip seals. In considering compounds for these it should be remembered that these packings must be stretched over the piston and allowed to snap into a groove, which may be a limiting factor in working up the rubber compound.

These applications are successfully handled by a high-quality nitrile rubber material or a PA-21 (polyacrylic rubber) material. The latter is the more expensive of the two, and the choice depends upon the temperature at a specific location.

"New Plastic Developments Reduce Interior Design Problems." T. R. Grimes, United States Rubber Co.

Plastic materials applicable to automotive interiors may be divided into formable materials, plastic foams, and breathable materials. Of the formable materials available, only the nitrile type gum plastics can be said to meet all the requirements of good automotive design.

Royalite, made by U. S. Rubber, is one of the nitrile type gum plastics available. Center pillar covers and instrument panel trim are two applications of this material.

Flexible plastic foams include the urethanes and vinyl chloride. These foams may be combined with other plastic film and sheeting products in the manufacture of such goods as instrument-panel safety pads.

The company also makes so-called Breathable Naugahyde, a discontinuous vinyl fabric coating applied by a variation in the process of cast vinyl coating. Upholstery that is smooth to the touch and has a lower specific heat value and lower rate of heat conductivity than conventional vinyl upholstery can be made with it.

"Decorative Elastomeric Floor Covering for Automobiles." J. F. McWhorter, Ohio Rubber Co.

Bright-colored rubber solvent dispersions sprayed on to an uncured rubber surface once proved commercially acceptable as automotive floor coverings. Water-dispersed or calendered film elastomeric coatings have generally replaced this technique. Elastomers most widely used for color coatings range in toughness between the high modulus vinyl and the low modulus butadiene-styrene copolymers.

The choice of rubber for automotive floor coverings provides such values as durability, conformability, flexibility, and insulation. These values are enhanced by the vinyl coatings, which are long-wearing, colorful, and easily cleaned. Textile-simulated floor coverings have been developed through the use of valley printing, lithographic printing, and embossing of calendered vinyl film.

"Headlining as Affected by Design and Styling Requirements." S. L. Terry, Chrysler Corp.

The lining of the roof is perhaps the most unusual and interesting trim problem in the automobile. Conventional headlinings are soft, that is, made of fabric or supported vinyl. Napped cotton is generally considered as a base line by which all other headlinings are measured. Vinyl headlinings are considerably more expensive. Paper and Saran headlinings have also been used.

It is expected that in the future, headlining assemblies will be molded in one piece and installed as a unit. Such headlining, made of U. S. Rubber's Royalite, is now being used in the Plymouth Suburban. This headlining has the texture and color of expensive vinyl headlining, but has a number of transverse ribs included in the design for the purpose of stiffening. The headlining is completely self-supporting, and moldings are used to cover the edges.

[1] Fluorocarbon plastic, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Synthetic Latex Seminar

A technical seminar on synthetic latex polymers will be conducted for the southern textile and paper industries at the Georgia Institute of Technology, Atlanta, Ga., May 4, under the sponsorship of the chemical division of The Goodyear Tire & Rubber Co., Akron, O.

Chief topics to be covered include the development, production, evaluation, properties, and uses of synthetic latices. Goodyear sponsored a similar seminar for the northwest paper industry in Camas, Wash., last October.

Keynote speaker at the Atlanta meeting will be Herman R. Thies, general manager of Goodyear's chemical division, who will give a general review of the industry.

Other Goodyear speakers and their subjects follow: J. D. D'Ianni, "Theoretical Consideration of Polymerization and Latex Characteristics"; A. E. Polson, "Sources of Materials for Latex Manufacture"; Willard C. Smith, "Properties of Latex Systems and Evaluation Procedures" and "The Influence of Latex Variance on Important Performance Characterisics"; and Earl W. Scott, "A Survey of Latex Applications and Potentials."

New York Talks on Foam, Electro-Charges, Ameripol

Latex foam, electrostatic rubber reinforcement, and synthetic *cis*-polyisoprene were the subjects of three technical papers presented before 180 members and guests of the New York Rubber Group at the Henry Hudson Hotel, New York, N. Y., March 23.

The speakers and their topics were: R. R. Waterman, R. T. Vanderbilt Co., Inc., "Latex Foam"; R. S. Havenhill, St. Joseph Lead Co., "Electrical Potentials in Rubber Compounding"; and E. B. Newton, B. F. Goodrich Co. Research Center, "Ameripol SN—A Synthetic *Cis*-1-,4-Polyisoprene."

Latex Foam

Mr. Waterman discussed the two processes through which latex foam is made: the Talalay process and the Dunlop process. In the first, the foam is chemically blown by releasing oxygen from hydrogen peroxide. In the second, the air is incorporated mechanically by whipping or mixing.

Latex foam consists of two initial dispersion systems: air in serum, and rubber globules in serum. The Vanderbilt researcher said the foam is quick-frozen in the Talalay process to prevent collapse when the cell walls rupture, while in the Dunlop system, the gelling action is so controlled that the rubber/serum coagulates before the air cells become interconnecting.

Viewing the latex foam of the future, Mr. Waterman said it would have a slower rebound in pillow applications, increased compression resistance for packaging and decorative uses, tailor-made properties for specific industrial needs, both open and closed cell structure, and more uniform processing characteristics to cut down scrap and to improve quality.

The talk was preceded by a 30-minute motion picture in color describing the manufacture of latex foam from the tapping of the tree to production of the finished commercial goods. Prepared for Mechanical Handling Systems, Inc., the locales of the film included Liberian plantations and various sections of the Buffalo, N. Y., plant of Dunlop Tire & Rubber Corp.

Electrostatic Potentials in Rubber

Mr. Havenhill described the electrostatic contact potential theory of reinforcement in rubber materials in which reinforcement is explained on the basis of the strong electrostatic attractive forces between the positive pigments and the negative rubber.

The role of the electrical potentials in determining the breakdown of the rubber and the proper sequence and timing of the milling operations during Banbury mixing was also outlined. Electrostatic mixing charts were presented which showed that by making the electrical charge on zinc oxide more positive, i. e., by coating, its incorporation rate can be increased. At the same time the positive coating produces improved dispersion and a 20% savings in power consumption.

The St. Joseph researcher declared that by following the changes in electrical potential of the rubber during mixing, it should be possible to improve on quality through better dispersion, as well as to reduce costs through proper sequence and timing of the mixing operations. New equipment for this purpose was described.

Synthetic Polyisoprene

Mr. Newton prefaced his talk by tracing the history of attempts to determine the nature of crude natural rubber from Michael Faraday's first efforts to the recent announcement by three American rubber companies that they had synthesized a *Hevea*-like rubber.

This speaker limited his discussion of these to his firm's Ameripol SN, made with a Ziegler-type catalyst acting on an isoprene monomer system. Physical methods of analysis, such as infrared spectra and X-ray diffraction patterns, which prove the polymer has a *cis*-1,4-polyisoprene configuration essentially similar to that of *Hevea*, were described.

The new rubber processes like *Hevea* and has the same good building tack, he said. After a small addition of lecithin and triethanol amine to act as a buffer material, the stabilized polymer produces vulcanizates in standard stocks showing physical properties, such as stress-strain and low hysteresis values, like those of similar *Hevea* rubber vulcanizates.

According to Mr. Newton, the performance of 11.00 x 20 heavy-duty tires, made entirely with Ameripol SN rubber, was comparable to that of similar *Hevea* rubber tires run in indoor tests, in controlled road tests in Texas, and in inter-city high-speed bus service.

Ordered Polymers Talk by Mayor at Buffalo Meeting

"Preparation and Properties of Ordered Polymers" was the subject of a talk by R. H. Mayor, The Goodyear Tire & Rubber Co., before the Buffalo Rubber Group at Hotel Westbrook, Buffalo, N. Y., March 7. Sixty-three members and guests were present.

Dr. Mayor termed the new class of polymers resulting from polymerization on a solid surface "something in the nature of a revolution" for the rubber and plastics industries. The development had its origin in the work of Karl Ziegler, of Max Planck Institute, and of Giulio Natta, of Milan Institute.

Controlling the propagation reaction on a solid surface leads not only to rapid conversion and high degrees of polymerization, but also to a more regular special arrangement of the individual monomer units in the polymer chain, the Goodyear researcher said.

The essential Ziegler catalyst, prepared by reacting an aluminum alkyl with a salt of one of the elements of the titanium, vanadium, or chromium families, polymerizes ethylene at atmospheric pressure. The polymer produced has a higher molecular weight and less branching than conventional polyethylene and, as a result, is denser, harder, stronger, and higher melting.

Outlining the work of Natta who has used this type of catalyst on such substituted ethylenes as styrene, butylene, and propylene, Dr. Mayor said that in these polymers every other carbon atom is unsymmetrically substituted and thus is capable of diisomerism.

The Italian scientist was said to have prepared polymers having the same configuration on all of these unsymmetrical atoms, at least for long segments of the polymer chain. Such polymers were highly crystalline and denser and stronger than conventional polymers of similar composition.

In this country, both Goodyear and Goodrich have indicated that this type of catalyst can be adapted for the conversion of isoprene to a synthetic version of natural rubber. Firestone has effected this conversion by using a lithium metal catalyst. For all practical purposes, the rubber is equivalent to the *Hevea* product, Dr. Mayor declared.

The new officers of the Buffalo Rubber Group have been reported as Charles W. Wahl, Hewitt-Robins, Inc., chairman; Charles Miserentino, Dunlop Tire & Rubber Co., vice chairman; and John Helwic, Dunlop, secretary-treasurer.

Quality Control Discussed At Chicago Rubber Group

"Modern Quality Control" was discussed by Simon Collier, Johns-Manville Corp., before 180 members and guests of the Chicago Rubber Group at the Furniture Club, Chicago, Ill., March 16. The meeting was held jointly with the Chicago Chapter of the Society of Plastic Engineers.

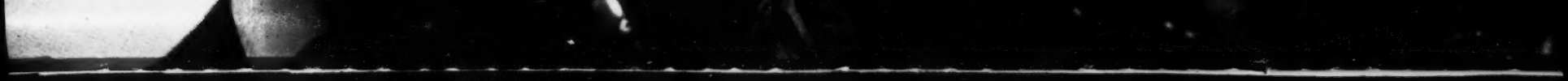
The science of quality control received considerable impetus during World War II when it became necessary to increase production beyond established records without the use of additional equipment or workers, Mr. Collier declared.

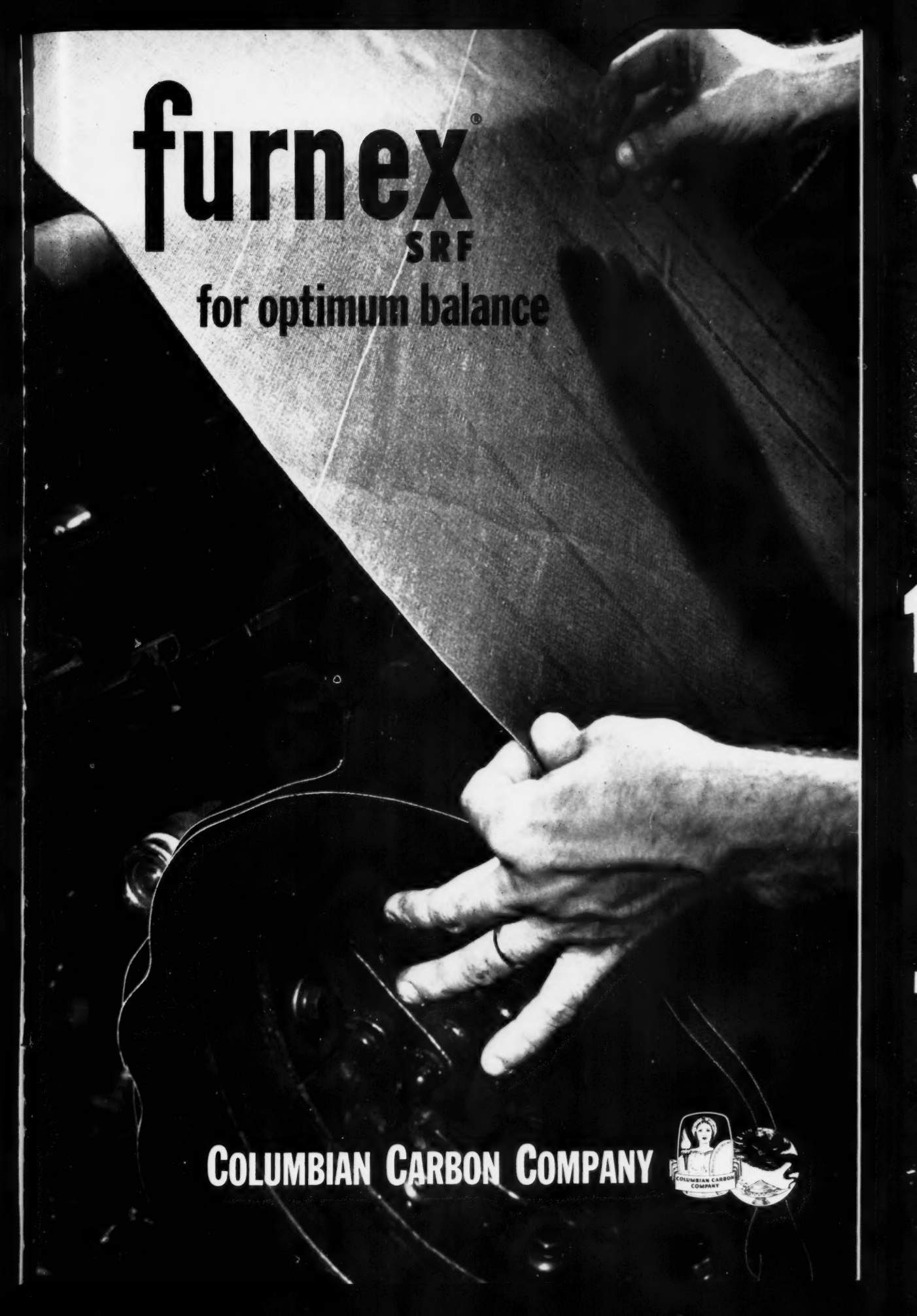
The main methods of carrying out a modern quality-control program were listed as visual aids, including charts and motion pictures; on-the-job training instruction; and quality-control meetings. It was pointed out, however, that the key to these techniques is to take the workers or their representatives into management's confidence and to "make them proud of doing a good job."

Using a statistical slide as illustration, Mr. Collier showed how a process at his company's Van Cleef plant was analyzed and subsequently improved, saving thousands of dollars.

The talk was concluded with a motion picture, "Modern Quality Control," which was based on operations at Johns-Manville plants.

The business session of the meeting featured a report presented by nominating committee members A. L. Robinson, Harwick Standard Chemical Co., chairman; Bruce Hubbard, Ideal Roller & Mfg. Co.; E. D. Ekkebus, Allis Rubber Co.; Steve Lillis, Victor Mfg. & Gasket Co.; and Ed Wagner, Witco Chemical Co.

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Polymers, Onus of Science Topics at Northeast Group

A symposium on "Characteristics of Bulk Polymers" was featured at a joint meeting of the Elastomer & Plastics Group, Northeastern Section, ACS, and the Northeastern Section, at the Massachusetts Institute of Technology, Cambridge, Mass., March 8.

Ray P. Dinsmore, The Goodyear Tire & Rubber Co., addressed the evening session on "Responsibilities of Scientific Leadership." Presided over by Walter Stockmeyer, MIT, the symposium consisted of talks by Richard S. Stein, University of Massachusetts, and Bruno H. Zimm, General Electric research laboratories.

Bulk Polymers

Speaking on "Some Optical Studies of Bulk Polymer Structure," Dr. Stein discussed his studies on the crystallization and structure of polyethylene in stretched, frozen, and melted forms. He said there were indications that the complex structure of the material resembled bundles of coils of chains which were connected both lengthwise and with interlinks.

Demonstrating his theory with slides and with mathematical formulae, the MIT researcher declared that the stretching and melting phenomena gave rise to specific types of interactions between the elements of this structure.

Dr. Zimm, expounding on "Relaxation Effects in Polymer Solutions," gave a theoretical presentation of the normal mode analysis of relaxation of polymer molecules in dilute solutions, presenting examples where the chains tended to rotate about an end, the middle, or sustained bending from stresses applied to the chain in several ways.

The mathematical data put forward indicated the analytical procedure to have many advantages in simplifying expressions for observed conditions. The G-E scientist said that the method was originally developed, in a simple form, by Newton, but was disinterred only recently.

Scientific Leadership

In his talk Dr. Dinsmore asserted that scientific achievements in both the military and civilian fields have tended to befuddle the public as to the precise place scientific workers hold in society today. Scientists themselves, he added, do not know what their duties and responsibilities are.

The Goodyear researcher called upon scientists to work out job specifications under proper titles and to publish them in an effort to assist technically inclined men and women in choosing the field for which they are best qualified.

He also condemned some scientific leaders for suppressing the natural curiosity of their assistants by keeping them on subprofessional work and by compelling them to labor over longhand-written reports instead of organizing their ideas and dictating them.

Castigating the cult of "personal magnetism" upon which some research leaders rely to inspire their assistants in the pursuit of solutions to technical problems, Dr. Dinsmore asserted that these assistants must be made to feel that they are equal members of a team by being allowed to participate in the planning of projects.

Similar problems, he continued, confront universities and the engineering societies. Here the training of young scientists should evoke in them a desire to be of service, and the tendency to regard entry into an academic career as a door to personal superiority must be replaced by the certainty that technical skills are valueless unless they contribute to the development of society and the economic structure.

Winner of the Northeastern Section's Richards Medal for 1956 is Melvin Kalvin, of the University of California, Chairman Arthur C. Cope, MIT, announced. Dr. Kalvin was selected for his work on the chemistry of photosynthesis. The award will be made at a May meeting at the Mallinckrodt Laboratories, Harvard University.

Butyl Talk in Connecticut; Dinner for Past Chairmen

"Practical Applications of Butyl Rubber" was the subject of a talk given by Jack L. Ernst, Esso Research & Engineering Co., before 160 members of the Connecticut Rubber Group at Tiernan's Homestead, West Haven, Conn., February 24. On February 23 a dinner commemorating the tenth anniversary of the Group and honoring past chairmen and their wives was held at Hotel Stratfield, Bridgeport.

Mr. Ernst described the increasing use of butyl in tire tubes and its growth in non-transport applications from 3% of the butyl consumed in 1946 to 14% in 1955. He said the rubber has been shown to be promising for sidewall and tread stocks[1] and for sponge underlay and sponge automotive weatherstripping.

In the higher range of temperatures, butyl is so heat resistant that in some cases it has been found to give better service than many of the specialized heat-resistant rubbers in its retention of stretch characteristics. For example, he said it was doing an outstanding job in tire curing bladders and bags which are exposed to repeated high vulcanizing temperatures.

Weatherstripping for cars is being made from butyl because of its ozone resistance. However, small quantities of GR-S type rubber, neoprene, or Hypalon, although ozone-resistant themselves, considerably undermine the ozone resistance of butyl. It is this incompatibility with other elastomers that has been one of the principal handicaps to the use of butyl, but Mr. Ernst believes this is now being overcome.

Otto J. Lang, educational committee chairman, reported that the Group would probably sponsor a lecture series in September which would cover a wide field of subjects of interest to the rubber technologist.

Charles R. Haynes, principal guest speaker at the tenth anniversary dinner, reminisced on his experiences in the rubber footwear industry from 1900 to 1925. He described the early formulations based on Fine Para rubber and litharge, and the variety of wild rubbers, mostly African, that were brought in to supplement the Fine Para supply.

When the price of Fine Para rubber soared to $3 a pound, Mr. Haynes related, footwear was made using very little new rubber. Acid process reclaim was therefore prepared from rubberized fabric scrap, which was softened on a mill with oils for reuse.

Chairman James Boyle, Armstrong Rubber Co., presented life membership cards to past chairmen in order of their service. They were W. J. O'Brien, Seamless Rubber Co.; Raymond Dudley, Whitney Blake Co.; Stuart Boyd, United States Rubber Co.; Donald Spengler, formerly with Sponge Rubber Co.; Carl Larsen, Whitney Blake; George Sprague, Sponge Rubber; Patrick Rooney, General Electric Co.; Guy DiNorscia, Sponge Rubber; and to Ward Fisher, Armstrong, in absentia.

[1] RUBBER WORLD, Oct., 1955, p. 59.

Polytechnic Lab Courses

The thirteenth annual series of Summer Laboratory Courses in the use of advanced chemistry and physics research tools will begin in late May at the Polytechnic Institute of Brooklyn. Introduced this year is a series of general evening lectures in polymer chemistry.

The laboratory program will consist of courses in X-ray diffraction, infrared spectroscopy, polarography and related techniques, polymerization and copolymerization techniques, properties of macromolecules in solution, and ion exchange. These courses will begin in the early morning, continuing until late afternoon. Enrollment in each course is limited to 20.

Inquiries and applications for registration should be addressed to Mrs. Doris Cattell, secretary, Summer Laboratory Courses, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y.

Galex Pellets on Market

Commercial production of a free-flowing, non-oxidizing, pelletized rosin for use as a plasticizer and softener in rubber compounding has been announced by G & A Laboratories, Inc., Savannah, Ga. Designated Galex Pellets, the product is said to resist fusing at temperatures up to 130° F. and not to cake under pressure when stored in stacked bags.

According to William L. Hopkins, Jr., secretary and treasurer of the company, the new rosin form was developed at Battelle Institute, Columbus, O., whose technologists also designed G & A's recently built processing plant where the material can be pelletized at a rate of 2,500 pounds an hour.

National Rosin Oil Products, Inc., New York, N. Y., has been named exclusive sales distributor for Galex Pellets.

Carpenter, Alliger Deliver Boston Talks on Synthetics

Paul G. Carpenter, Phillips Petroleum Co., discussed "Recent Developments in Synthetic Rubber," and Glen Alliger, The Firestone Tire & Rubber Co., "The Properties and Applications of Coral Rubber—a Synthetic *Cis* Polyisoprene" at the March 16 meeting of the Boston Rubber Group, Hotel Somerset, Boston, Mass. Presided over by Chairman James E. Williamson, Tyer Rubber Co., the meeting was attended by 120.

Dr. Carpenter outlined the use of low-pressure polyethylene (LPP) as a reinforcing agent for rubber and discussed the compounding of vinyl pyridine ester-butadiene copolymers and terpolymers with acrylonitrile, which produces a series of synthetic rubbers said to have unique advantages as tire stocks, including treads.

Trade marked Marlex 50, the LPP reinforcement results in compounds showing half as much H_2 gas transmittance at 30% loading as a straight cold-rubber stock, the Phillips researcher said. Shoe sole stocks containing the material exhibited abrasion resistance twice as good as that of two high-styrene-resin stocks tested, while having a lower Shore hardness.

In a series of GR-S 1500 type stocks, portions of the rubber were systematically replaced with LPP while the carbon black filler was reduced, resulting in tire stocks that gave better tread wear and had lower heat build-up, according to Dr. Carpenter.

He theorized that during the processing of LPP-containing stocks, a change in solubility of the LPP in the rubber phase took place. Minute particles of LPP came out of solution and formed finely divided reinforcing material on the surface of the elastomer.

Turning to his company's work with vinyl pyridine rubbers, he spoke of the quarternization reaction with halides that produces the three methyl-vinyl pyridine-butadiene copolymers and the terpolymer with acrylonitrile. The company's Philprene VP has a 2,500 psi. tensile strength, with a high Shore hardness. VP-15 has a Gehman freeze point of —63° F. After-oven tests of the terpolymer were said to be encouraging.

Mr. Alliger compared Firestone's Coral rubber with the tree-grown product, calling them similar in most respects. The synthetic rubber, however, is crystalline in structure, has better rebound, a lower stress relaxation, exhibits improved skid loss in truck tires, and results in less cracks in tire tread grooves, according to this speaker.

The Coral rubber also ages better than *Hevea* stocks after cures of 60 minutes at 280° F., but not so well as LTP GR-S type stocks. Cut growth properties are the same as for *Hevea;* while tensile retention and low hysteresis values make the Coral rubber superior to LTP GR-S type rubber. Energy absorption is twice that of LTP GR-S type rubber at constant force, according to Mr. Alliger, and four times that at constant amplitude.

Guest speaker at the Group's evening dinner was Samuel Ramsey, whose subject was "The Value of a Sense of Humor in Industry." Arthur I. Ross, American Biltrite Rubber Co., chairman-elect, presented brief business reports.

Fluorocarbons Topic of Kellogg's Honn at SORG

Frank Honn, M. W. Kellogg Co., spoke on "The Search for a Fluorocarbon Elastomer" before 81 members and guests of the Southern Ohio Rubber Group at the Engineer's Club, Dayton, O., March 8.

Illustrating his talk with slides and a large display of sample elastomers, Dr. Honn pointed out that the synthesis of an elastomer containing a great proportion of fluorine is not an easy matter because fluorine makes polymer chains stiff and plastic, rather than elastomeric.

Nevertheless, research during the past several years has uncovered three general methods for this synthesis. They are co-polymerization of butadiene with fluoro-olefins, polymerization of partially fluorinated dienes, and copolymerization of fluoro-olefins to produce a saturated polymer chain containing enough hydrogen to provide flexibility, but not enough to destroy the heat- and chemical-resistance of fluorine polymers.

Examples of the third class are Kel-F Elastomers 5500 and 3700, copolymers of chlorotrifluoroethylene and vinylidenefluoride. The Kellogg researcher said that these new rubbers, which can be vulcanized effectively with peroxides and polyamines, have found application in hose, seals, diaphragms, and other specialized items which must handle strong acids, oxidants, and hot fuels and oils.

During the business session of the meeting, SORG's educational committee revealed that it was making plans for a series of rubber technology lectures to include all or some of the following subjects: properties and applications of natural and synthetic rubbers; rubber processing fabrication; rubber compounding materials and their functions; and engineering of rubber products. Kenneth Tregillus, Vernay Labs, Inc., and Fred Gage, Dayton Chemical Products Labs, Inc., are co-chairmen of the educational committee.

Outgoing chairman of the Group, Frank Newton, The Dayton Rubber Co., introduced the new chairman for 1956, James R. Wall, Inland Mfg. Division, General Motors Corp.

Silicone Compounding Talk By Servais at L. A. Group

P. C. Servais, Dow-Corning Corp., spoke on "Compounding of Silicone Rubber" before 268 members and guests of The Los Angeles Rubber Group, Inc., at the Hotel Statler, Los Angeles, Calif., March 6.

The silicone polymer is a clear and colorless organic-inorganic viscous fluid, usually dimethyl siloxane. Variations in the organic portion of it, such as the introduction of phenyl and vinyl groups, enhance low-temperature performance and ease of vulcanization, according to Mr. Servais.

The fillers used in compounding silicone rubber are inorganic oxides that have heat stability, fine particle size, good electrical behavior, and do not harm the other ingredients. Additives are employed to produce color, better heat stability, sponge, and low compression set.

Vulcanizing agents employed are the strong organic peroxides which decompose when heated and develop cross-linking through the organic portion of the polymer. The Dow-Corning researcher warned of the importance of avoiding contamination during compounding because organic materials dissipate the vulcanizing agent.

Guest speaker at the meeting was John F. Malone, in charge of the Los Angeles office of the Federal Bureau of Investigation. "Functions of the FBI" was his subject.

Nine door prizes, contributed by Los Angeles companies, were distributed by M. A. MacDonald, Midwest Rubber Reclaiming Co., prize committee chairman.

Washington Conveyor Talk

Frank Blanchard, manager of operations for Hewitt Rubber Division, Hewitt-Robins, Inc., Stamford, Conn., addressed 29 members and guests of the Washington Rubber Group at the Pepco Auditorium, Washington, D. C., February 15, on the subject of "Rubber Railroads."

Dealing with a history of rubber belt transporting, the talk traced conveyor belt systems from the work of Thomas Robins in the 1890's, who applied rubber to the wearing surface of a belt and invented a practical idler pulley that eliminated the need of a so-called skirt-board to guide moving belts, to present developments in the field.

Mr. Blanchard discussed the introduction of ore, debris, construction materials, passenger, and other types of conveyor belts. He expressed optimism for the future of these devices "wherever quantities of congruent units, whether bulk or package materials, require smooth, gliding, uninterrupted transportation from loading station to distant destination."

Doubling Hetron Facilities

Hooker Electrochemical Co., Niagara Falls, N. Y., is doubling the capacity of its Hetron polyester resin manufacturing facilities because of a substantially increased demand for the products. Completion of the project is expected by June.

Hooker makes eight Hetron resins.

Citing one example of this increased demand, Hooker says that Resolite Corp. and Filon Plastics Corp. have incorporated the resins in new fire-retardant panels which carry the approval of Underwriters' Laboratories.

NEWS of the MONTH

Washington Report and National News Summary

. . . A bill for the disposal of the alcohol-butadiene plant at Louisville, Ky., and a butadiene catalyst plant at Baltimore, Md., became law on March 21. Disposal by June of these two plants is likely since they are important factors in full-scale operation of the Goodrich-Gulf, Inc., Institute, W. Va., GR-S type rubber plant.

. . . The Government Laboratory at Akron, O., will be turned over to the General Services Administration on July 1 and then offered for sale according to a bill introduced in Congress during March.

. . . Duplication of the federal tax on tubeless tires found in current pending legislation before Congress is being corrected; payment of tire excise tax by all dealers on receipt of tires from manufacturers may soon become law; and a floor stock tax on tires and tread rubber to take effect with passage of the highway bill in this session of Congress is being opposed by the industry on timing only.

. . . Rubber footwear industry claims further decline of that industry will result if H. R. 5550 approving United States membership in the Organization for Trade Cooperation is passed. Tariff cuts likely to follow OTC membership would make it extremely difficult for the domestic footwear industry to compete. Preliminary 1954 Census Bureau figures show significant decline in footwear industry production, sales and employment since 1947.

. . . Attempt of Edward Lamb, of Toledo, O., to gain control of Seiberling Rubber Co. will be aired further at stockholders' meeting on April 25.

Washington Report

Louisville, Baltimore Plant Disposal Bill Now Law; Outlook Good, But Lease Rather Than Sale Likely

Reflecting Congressional confidence in the government's ability to get a good price for its synthetic rubber facilities, legislation authorizing long-term disposal of the alcohol-butadiene plant at Louisville, Ky., breezed through Congress last month in less than a week.

Congress Acts Fast

Congress had a deadline to meet early in March and met it. The Rubber Producing Facilities Disposal Commission would have finished up its work by March 22 as far as the Institute plant disposal was concerned, but then the Senate Banking & Currency Committee met on March 9 to consider legislation for the disposal of the alcohol-butadiene plant in Louisville, Ky. A few days later, on March 13, a bill for the disposal of this plant was on President Eisenhower's desk; it was signed on March 21, and the Disposal Commission was back in business.

The whirlwind treatment of the bill on Capitol Hill went like this: On Friday, March 9, the Senate Banking Committee held a short hearing, then voted out a bill to sell or long-term lease both the Louisville plant and government-owned equipment for butadiene catalyst manufacture sitting in a Davison Chemical Co. plant at Baltimore, Md. On Monday, March 12, the bill was speeded through the Senate and sent to the House where it was passed on March 13 without so much as a hearing.

Louisville, Baltimore Disposal Factors

The Disposal Commission, poised to go out of business following completion of the Institute, W. Va., plant sale to Goodrich-Gulf, Inc., heaved a patriotic sigh and took on the task of disposing of the Louisville and Baltimore facilities. It, too, has a deadline—if long-term disposal is to come this year, the deal must be in the hands of Congress, for its consideration, 30 days before adjournment in mid-summer. At this point the Commission thinks it can do the job in time to get it finalized by the legislators.

Except for the Government Laboratory facilities at Akron, the Louisville butadiene plant and the catalyst equipment at Baltimore are the only synthetic rubber facilities remaining in government ownership. The Disposal Commission is authorized to put both on the market for (1) sale at a "fair value" price or (2) lease from five to 15 years.

The Louisville plant is one of two alcohol butadiene plants offered for sale by the Commission in 1954. One, at Kobuta, Pa., was sold to Koppers Co., Inc., last year, under a 10-year national security clause. Koppers utilizes the power equipment at Kobuta, but the rest is in standby.

In the absence of offers for the Louisville plant during the 1954-55 disposal period, it was leased to Publicker Industries, Inc., for a three-year term ending in April, 1958. Under this short-term lease arrangement the government pays for maintenance of the two production lines in standby; Publicker pays $6 per ton for butadiene produced by the third line.

The equipment at Baltimore was specifically fabricated to produce the catalyst essential to the production of alcohol butadiene. Moreover, it is the only equipment now in existence capable of producing the catalyst. Since the equipment is essential

to the operation of the alcohol-butadiene facilities at Louisville and Kobuta, the government has a national defense interest in keeping it operative so long as the Louisville and Kobuta plants are important. At the same time, Publicker has only enough of the catalyst to last through 1956.

Publicker, which, because of its alcohol-manufacturing facilities in New Orleans, can effectively compete against petroleum butadiene, is almost certain to take over long-range operation of the Louisville plant. The company is the only firm to have expressed interest in buying this plant from the time it was first offered for sale.

The major factor in the disposal of the Louisville facilities at this time was the recent finalization of the government's sale of its Institute synthetic rubber plant to Goodrich-Gulf. Just as soon as Goodrich-Gulf completes its modernization and expansion program at Institute, it will become a good customer for Louisville butadiene. At the same time, however, Louisville, was not a good long-range risk until the Institute transaction was cleared by the government.

As Laurence R. Brown, a Publicker official, told the Senate Banking Committee, however, Publicker could not see its way clear to launching an expansion program at Louisville without some long-term commitment from the government.

"We cannot amortize heavy investments in three years," Mr. Brown reminded the Committee.

These investments, he indicated, were a "must" in meeting new demands for butadiene and putting the plant on a profitable basis.

A high-ranking member of the committee, Senator Homer Capehart, an Indiana Republican, offered a mild protest to disposal of the Louisville plant while the Publicker lease still had two years to run. He withdrew the objection, however, when the committee reached an agreement to subject any long-term lease which might be negotiated to Congressional review. The same amendment took care of another Capehart objection which he voiced very succinctly:

"It looks to me like we are doing business with you (Publicker) and you alone."

Mr. Brown, however, said there was no reason why the Disposal Commission could not arrange to sell or rent the Louisville plant to some other firm. Since either deal would be subject to the Publicker lease expiring in April, 1958, he said, an interested buyer might welcome the two-year waiting period to arrange for a source of alcohol.

Disposal Outlook Good

Meanwhile the Disposal Commission has launched its hunt for a buyer, with Publicker having the inside track. The Commission favors both the sale or long-term rental with provision for later sale. It advised the Senate Banking unit, however, that it believed "the possibility of a satisfactory sale to be highly remote. It is the Commission's opinion that a longer-term lease (than the one now in effect) provides a more feasible solution."

If no sale of the plant can be effected, the Commission is authorized to enter into a lease running from five to 15 years beyond April, 1958. The same process applies to the catalyst equipment at Baltimore, where Davison is first in line as a possible new operator. Sale of the Louisville plant would follow the procedure proved so successful in the sales of the plants at Baytown, Tex., and Institute, W. Va. Sale of the catalyst equipment would follow the procedure employed in disposing of the tank-car fleet. In both instances the Attorney General would review the disposals from the standpoint of promoting competition.

Publicker's plans for Louisville, if it is the successful bidder, are no secret. When the Institute plant demand develops, output of butadiene at Louisville will be doubled to upward of 60,000 tons a year. The fate of the third production line—capable of producing another 20,000-30,000 tons—rests with the supply-and-demand situation which evolves in the next few years.

Thus, the disposal picture adds up to a very favorable one for both the government and the producer, as noted by the Senate Banking Committee:

"There is a substantial shortage of butadiene. This has created a situation which makes it probable that these facilities could now be disposed of, either by sale or by long-term lease, under conditions which would be beneficial both to the producers and consumers of synthetic rubber and to the government and the taxpayer."

Akron Lab Disposal Bill; GSA Takes over July 1

The Administration last month launched Plan No. 2 of the National Science Foundation for disposal of the government-owned synthetic rubber research facilities at Akron, O. NSF recommended last December that the government do one of three things, in this order: (1) lease the facilities to the only operator in the history of the installation, Akron University; (2) offer the facilities for negotiated sale to private industry; or (3) transfer them to the National Bureau of Standards.

Following rejection of Plan No. 1 by Akron University, NSF drafted the bill which was introduced in Congress last month after approval by the interested executive agencies, including the Justice Department and the Bureau of the Budget. The proposal's major provisions would: (1) transfer jurisdiction of the Akron Government Laboratory from NSF to the General Services Administration, effective July 1; (2) authorize GSA to offer the Laboratory for sale; and (3) authorize GSA to make whatever other disposal it deems appropriate if no "fair market value" offer is received.

Akron University, which has operated the combined lab-pilot plant installation since it was built 12 years ago, rejected a government offer of one-year lease (offered without government subsidy) in February. The University's cost-plus-fee contract expires June 30, when the facilities will be turned back to Uncle Sam.

The Administration's new proposal differs from the legislation on disposal of the synthetic rubber producing facilities in that any contract of sale covering the Government Laboratory would not contain a national security clause requiring the facilities to be kept available for possible mobilization. While this feature may not seem important on its face, it could make a big difference to a buyer who was more interested in having a free hand with the equipment and buildings involved than he was with operating the installation as presently constituted.

Lending weight to this possibility is the fact that NSF, as agent for the government, spends $900,000 annually to operate the Laboratory. Sources in the industry point out that no small rubber company could afford this expense for research; while the large companies have extensive research facilities of their own.

Another factor important in the earlier disposals of production facilities was the government's preoccupation with preserving a competitive, monopoly-free status in the synthetic rubber industry. As emphasized recently by a spokesman for the government, monopoly does not enter the Akron Laboratory picture because "there is nothing unique about these facilities." He conceded monopoly would be a consideration "if these were the only such facilities" for synthetic rubber research, but pointed out that "no company would get anything approaching a monopolistic advantage by buying them."

Two Tire Tax Problems

The rubber tire manufacturers found themselves in a two-way squeeze last month when the Forand subcommittee of the House Ways and Means Committee came up with a long list of recommendations aimed at solving certain administrative problems in the collecting of federal taxes. Among other things, the unit recommended: "Tubeless tires should be taxed at a rate one cent a pound higher than tires requiring separate inner tubes. This is recommended to preserve existing revenues from tires and tubes."

Tubeless Tires

The culprit on this suggestion was the House Subcommittee on Excise Tax Technical and Administrative Problems, headed by Rep. Aime J. Forand, Rhode Island Democrat. The suggestion sent Washington representatives of the tire industry scurrying up to Capitol Hill to correct an obvious oversight—Congress was imposing a tax which had already been included in the pending highway bill.

Moreover the tire industry, in throwing its support to the Administration's highway bill, had taken the 1¢ tubeless impost into consideration in calculating what it would cost its customers. Staff members of the Forand subcommittee immediately recognized the duplication and promised an attempt to clear it up. Their strategy was simple:

To strike out the onerous language from the list of Forand subcommittee recommendations before it reached the House floor.

Tire Tax at Source

Meanwhile the National Tire Dealers & Retreaders Association was rejoicing in another Forand recommendation: "The tax on tires and inner tubes should be levied at the time the tire or tube leaves the manufacturing plant or a warehouse within 20 miles of such plant, instead of the time of the sale by the manufacturers."

In many appearances before Congress on the need of this change in the law, the Association had leveled a "discrimination" charge against tire manufacturers having their own retail outlets. These retailers, according to the independents, paid no excise tax until the retail sales were completed. On the other hand, they contended, independents had a substantial part of their inventory tied up in prepaid taxes.

In his final Congressional appearance, before the Forand group issued its multi-recommendation report, Association Executive Secretary W. W. Marsh summed up his group's position this way:

"Under the present tax structure of 5¢ per pound tax on new tires and 9¢ per pound on tubes, the dealer . . . now has 6.3% of his capital investment tied-up in prepaid inventory.

"The tire dealer must pay the tax in advance; that is, when he buys from his supplier. Under the industry's present system, the tax on new tires is not included in the retail price of the tire so that the tire dealer is unable to get back what it costs him to handle the tax.

"In contrast to this, company-owned stores do not pay their excise tax until after they sell the merchandise. These company-owned outlets therefore have 6.3% less capital tied up than their independent tire dealer competitor."

Both Forand subcommittee recommendations affecting the rubber industry came after extensive public hearings last fall and early this year on virtually every excise tax administrative problem. After clearance by the parent Ways and Means Committee—in the form of a committee report—the surviving recommendations will be incorporated in a bill subject to House and Senate consideration. Chances for final approval of an administrative bill in some form are considered good.

Timing on Highway Bill Floor Stock Tax Opposed

Congressional action on the compromise highway bill, which got off in high gear early in the present session and then slowed down considerably, posed a new problem last month to tire manufacturers. The House Ways and Means Committee, in reporting, to the House floor the all-important money-raising bill (H. R. 9075), scheduled July 1 as the key date for taxing floor stocks on tires. Specifically, the committee authorized the Treasury Department to impose a floor stock tax of 3¢ a pound on:

"Tires of the type used on highway vehicles held by a dealer for sale or held for sale in connection with other articles or used in the manufacture of other articles"; and

"Tread rubber held by a dealer. . . . The tax in this case is not to apply in the case of any person who establishes to the satisfaction of the Treasury Department that all of the tread rubber held by him will be used otherwise than in the recapping or retreading of tires of the type used on highway vehicles."

While the manufacturers have not opposed the tire tax, as such, they are understandably opposed to the effective date. Coming at a time when the selling season will be in full swing, the tax is almost certain to cut down sales. Dealers are expected to be wary of incurring a big tax bill which could not be passed on to the consumer. Thus, the Rubber Manufacturers Association Washington spokesman for the tire industry was exerting pressure to get the date postponed. Failure to get a several-months' delay, it feared, would cut sharply into normal spring stock build-ups and thus cost the industry several millions of dollars.

Rubber Footwear, Organic Chemicals Oppose OTC; Claim Death of Domestic Industry in H. R. 5550

Two of the loudest voices raised last month against United States membership in the Organization for Trade Cooperation (OTC) were those of the rubber footwear and coal-tar dye industries.

Both predicted a speedy end to domestic manufacturing of their products if Congress gives its approval to H. R. 5550, the authorizing legislation for U. S. participation in OTC.

In a fighting mood, spokesmen for the two industries left these warnings with the House Ways and Means Committee during the two weeks of hearings on H. R. 5550:

Cornelius P. McFadden, chairman of the RMA Footwear Division, predicted: "Loss of an industry that was vitally needed in time of war emergencies; loss of this industry's research experience and facilities, which are continuously employed on development of protective footwear for the Armed Services; loss of jobs for more than 25,000 American men and women; and loss of the skills that these men and women have acquired through years of experience."

Sidney C. Moody, representing the Synthetic Organic Chemical Manufacturers Association, said flatly that OTC would be a step toward wiping out the system which "Congress developed . . . to permit a domestic organic chemical industry to become strong in the face of the particularly ruthless practices which the European chemical cartels used" before World War II.

H. R. 5550 and OTC

H. R. 5550, which would give the go-ahead to the Administration's deep desire to join OTC, has developed into one of the most explosive bills in the legislative hopper. Under it President Eisenhower would be authorized to accept membership in history's largest international trading agency, set up to administer the 35-nation General Agreement on Tariffs and Trade (GATT).

The controversial bill—only 260 words long—incorporates by reference the proposed OTC charter. The charter, in turn, incorporates by reference (1) the 54-page text of GATT, (2) the interpretations of the text embodied in GATT's official 800-page "Basic Instruments and Selected Documents," and (3) the 60,000 tariff concessions negotiated to date by the 35 member countries.

GATT itself, which dedicates its members to free-trade principles, has never been submitted to Congress, a point which the opponents of H. R. 5550 raised again and again during the Ways and Means Committee hearings. By accepting OTC, they warned, Congress would be surrendering its powers over tariffs and accepting international supervision. Thus, it was contended, Congress would delegate to an international agency subject to control by foreign power (it would take a majority or a two-thirds vote to transact OTC business) its authority to supervise U. S. laws and regulations.

By the Trade Agreements Act of 1934, Congress entrusted to the President, and the President delegated to the State Department, authority to negotiate tariff-cutting agreements with other nations. GATT is a master agreement embodying in one instrument the result of 20 years of these negotiations. For example, the U. S. is engaged right now, with 25 other nations, in the fourth round-robin bargaining session on tariffs since 1948; firm results of these Geneva talks will not be reached until late spring. The U. S. has $1.8 billion of its 1955 export-import trade up for possible tariff cuts.

Footwear Opposition

The secrecy surrounding negotiations like these was strongly criticized by Mr. McFadden when he protested the GATT-OTC arrangement on Capitol Hill. He aimed his barb specifically at the State Department's handling of last year's negotiations with Japan and several other nations. The State Department did no more, he complained, than issue the announcement that a list of rubber products would be opened to negotiation. Mr. McFadden emphasized that the list embraced "thousands and thousands" of rubber products; then he asked these questions:

"Does such an announcement give proper and adequate notice to interested persons as to what the negotiations are all about? How can the hundreds of rubber manufacturers have the faintest idea of what may befall them in such conferences? How can they defend themselves? How can the Committee for Reciprocity Information [a tariff investigatory agency] make an adequate investigation so that the American negotiators will go to the conferences with full information needed to protect American interests?

"The United States manufacturers and

their employes, whose fate rests with the American delegates to these conferences, are completely in the dark as to the considerations that determine the final decisions; and the negotiators cannot possibly be fully enlightened on the conditions within the various industries that should guide their thinking."

Mr. McFadden said the footwear industry opposed H. R. 5550 because "we are convinced that it is a dangerous bill; that it would expose American industry and American workingmen, and ultimately the American public, to serious danger; and because we know that the Rubber Footwear Industry is most vulnerable to the harm that would follow the passage" of the bill.

He spoke on behalf of 14 domestic manufacturers of waterproof rubber and rubber-soled fabric-upper footwear who produce more than 90% of these items: Bata Shoe Co., Bristol Mfg. Corp., Cambridge Rubber Co., Converse Rubber Co., Endicott Johnson Corp., Goodyear Footwear Corp., Goodyear Rubber Co., Hood Rubber Co. (Division of The B. F. Goodrich Co.), LaCrosse Rubber Mills Co., Mishawaka Rubber & Woolen Mfg. Co., Servus Rubber Co., Tingley Rubber Co., Tyer Rubber Co., and United States Rubber Co.

"Our industry has seen the handwriting on the wall," Mr. McFadden told the legislators. "We have lost our export markets which were a substantial part of our production. Unless our government is prepared to recognize the facts of economic life, we face the fate that has befallen the rubber footwear industry in Canada—loss of the domestic market."

Canada, he declared, was already on the verge of succumbing to competition from imported footwear "chiefly made in Hong Kong at coolie wage levels."

Mr. McFadden also complained bitterly that Congress, in adopting the Reciprocal Trade Program, had relinquished to the Executive Department the authority to make vital decisions on tariffs and trade. This move, he said, had effectively insulated the government's trading experts from the industry people affected by their decisions.

"GATT would transfer this authority over tariffs and trade to an even more remote plateau—an international organization which proposes to take over all the economic problems of the world," he argued. "With such a tremendous task on its hands, we doubt that GATT would be much concerned over the fate of some 25,000 persons employed in the rubber footwear industry."

Organic Chemical's Concern

Organic Chemical Spokesman Moody was equally strong against OTC, even going beyond the Manufacturing Chemists' suggestion to conduct a thorough study of OTC before deciding either way as to U. S. membership. Mr. Moody asked outright disapproval of this country's participation.

Certain trades rules OTC would administer under GATT, Mr. Moody explained, "would be very detrimental to the interests" of his industry. He named these as:

1. Article VII of GATT, which, he said, would prohibit the duty valuation of imported organic chemicals on the basis of similar products which are made in the United States.

2. The GATT rule specifying that the value of imported merchandise for customs purposes should not be based on arbitrary or fictitious values.

3. The escape-clause provision of the General Agreement (Article XIX), which, he contended, "differs materially from the escape clause which Congress has provided in our domestic law."

After a fortnight of public hearings characterized by spirited testimony on both sides of this thorny question of OTC, Capitol Hill observers were making this prediction for H. R. 5550: That it would clear the House after a hot debate, but would wallow and die in the Senate.

New Import Problem for Footwear Manufacturers; 1954 Census Figures Show Industry Decline

The rubber-soled footwear manufacturers have had to go back to Congress for loophole-plugging legislation on imports only three years after they persuaded the government to plug the last hole in the tariff screen. Whereas a 1953 fight between domestic and foreign manufacturers whirled around rubber-soled imports with mid-soles of leather, the new outbreak involves rubber-soled shoes with leather tongues.

"Leatherized" Rubber Footwear

The overall picture is one of clever evasion of the high United States duties which apply to most products of the rubber footwear industry. Rubber-soled footwear is dutiable on the basis of American selling price for a similar or identical item; leather imports, on the other hand, are dutiable on the basis of foreign price. Because of our high standard of living, foreign prices are invariably lower than ours.

In 1953, certain foreign manufacturers began to move into the American market with a type of footwear which looked like an ordinary tennis shoe, but which had a mid-sole of leather. Since the leather qualified the shoe as a leather-soled item, it carried a much lower impost than a cheaper shoe entirely soled with rubber. The 83rd Congress, at the behest of domestic manufacturers threatened with injury, enacted a law in order to close this loophole in the tariff law.

Now certain European manufacturers, reputedly in the United Kingdom, The Netherlands, and/or Italy, are reported to be sending into this country tennis-type shoes with leather tongues. They are clearly attempting to evade the American-selling-price-rated duty applicable to the same shoes free of leather.

To head off a flood of leather-tongued shoes, two Connecticut Republicans, Senator Prescott R. Bush and Rep. Antoni N. Sadlak, have introduced legislation to subject all rubber-soled shoes to the American-price tariff if any part of the upper is "wool, cotton, ramie, animal hair, fiber, rayon, or other synthetic textile, silk, or substitutes for any of the foregoing, but not composed wholly or substantially wholly of leather."

If the experience of the 1953 legislation is any indication, the Bush-Sadlak proposal should slide through Congress this session with a minimum of opposition and debate. The measure is a simple amendment of the Tariff Act of 1930 which would redefine rubber-soled footwear and direct the President to modify or terminate international obligations which might conflict with the new definition.

The U.S. Tariff Commission estimates domestic production of rubber footwear to be in the neighborhood of 50 million pairs. Imports, except during periods of tariff-dodging gimmicks like the leather-tongue design, are described as relatively small.

Footwear Industry Decline

The Census Bureau, which just completed a 1954 census of the domestic industry, reports a general shrinkage of the industry between 1954 and the year of the last previous census, 1947. According to the Census data, the industry shipped upward of 70 million pairs of rubber footwear two years ago, as against about 75 million in 1947.

The total value of all products shipped by rubber footwear manufacturers in 1954 fell off by 17% from $198.7 million to $165.9 million. Average employment in the industry dropped 35% to a total of 18,200 during the same period. Not all of the industry's shipments, of course, were footwear. Of the $166 million total, $141 million represented footwear and other products primary to the industry, and $25 million represented products primary to other industries, such as rubber heels and soles. Thus the industry's shipments of rubber footwear represented 85% of its total product shipments.

Other significant changes from 1947 were: number of establishments, down from 26 to 21; annual payroll down from $72.7 million to $63.9 million; and capital expenditures, down from $5.0 million to $4.2 million.

Commerce Defense Planning

The Commerce Department took a major step toward stepping up defense planning last month when it held a comprehensive briefing for more than 30 representatives of the rubber, organic chemical, and 12 other key industries. The briefing was the first in a series designed to broaden industrial preparation to meet the threat of nuclear attack.

Until the new approach to planning was adopted earlier this year, the defense measures of the Commerce Department's Business & Defense Services Administration had been limited to helping individual rubber and chemical companies plan their defense

programs. Under the broadened plan, administered by BDSA's director of industrial defense, William E. Haines, the agency will also extend help to industry and business groups like the RMA, the American Coke & Coal Chemicals Institute, and the Manufacturing Chemists Association.

The March meeting was highlighted by a Defense Department presentation on "The Production Allocations Plan," but also included talks on: "Attack Damage Assessment Problems," by the Office of Defense Mobilization; "Meteorological Aspects of Radioactive Fallout," U. S. Weather Bureau; "Plans for Continuity of Banking Operations in Event of Attack," Federal Reserve Board; "Planning for Continuity of Communications in Event of Attack," American Telephone & Telegraph Co., and "Mobilization Control Planning," BDSA.

Industry News

Seiberling Board Is Packed As Proxy Fight Continues

The bitter proxy fight for control of Seiberling Rubber Co., Akron, O., is expected to receive further airing at the firm's annual stockholders meeting, April 23.

The dispute was first made public in February when J. P. Seiberling, company president, revealed the contents of a letter he had sent to Edward Lamb, a Toledo, O., financier, who is seeking control of the Seiberling firm.

In the letter Mr. Seiberling made known that Mr. Lamb had demanded either that five of his nominees be elected to the company's directorate or that four be elected and that he nominate as well an executive vice president or similar executive officer and one member of a three-man executive committee.

The request was then denied. In March, Mr. Seiberling counterattacked by announcing that the nine-man board of directors would be increased to a membership of 15. Two new members, Paul A. Frank, president of National Rubber Machinery Co., and L. M. Buckingham, a director of several companies, were selected, leaving four vacancies to be filled by Mr. Lamb.

This move would give the incumbent leadership of the company clear control of the board of directors with 11 out of 15 members. The final composition of the board will, of course, have to await the outcome of the proxy contest. In 1954, Mr. Lamb took over control of Air-Way Electric Appliance Corp. by acquiring a sufficient number of proxies.

In a public statement criticizing Mr. Lamb's intentions, Mr. Seiberling said he was convinced that most stockholders would agree it is better to have the company grow on a sound basis "than to be added to the collection of smaller companies Mr. Lamb has been busy acquiring, either at the bottom or at the top of his financial pyramid."

According to Mr. Seiberling, Mr. Lamb's report of holdings filed with the Securities & Exchange Commission, March 6, showed direct beneficial ownership of 62,831 shares. Holdings of his associates are said to have raised the total to 79,241 shares. In a more recent public statement, Mr. Lamb claimed to have 115,000 of the company's 414,916 common shares.

E. R. Weidlein Retires as Mellon Institute President

Edward R. Weidlein, scientist, research administrator, and author, has retired as president of the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

An important figure in the American synthetic rubber industry since its beginnings, Dr. Weidlein served as technical adviser to the Rubber Reserve Co. and then the Synthetic Rubber Division of the Reconstruction Finance Corp., from 1941 on.

During World War II he was a member of the Research Committee in Cooperation with the Chemical Warfare Service of the American Chemical Society and of the Committee on Cooperation with the National Defense Research Committee of the Office of Scientific Research & Development.

Dr. Weidlein was chief of the Chemicals Branch of the War Production Board from 1940 until 1942, and senior consultant of the WPB Chemical Division from 1942 until 1946, as well as head technical consultant of the WPB during that period.

He also served as technical adviser of the research and development division of the U. S. Army's Quartermaster Corps, member of the research advisory committee of the committee on research and patents of the National Association of Manufacturers and its chairman in 1944, and member of the American Citizens Committee for the United National Scientific Conference on the Conservation & Utilization of Resources.

With the Mellon Institute, he served as senior fellow from 1912 to 1916, executive staff member from 1916 to 1951, and president from 1951 until the present. He was also a trustee of the University of Pittsburgh, with which the Institute is allied.

Among the many scientific awards he has received are the 1935 Chemistry Industry Medal of the American Section of the Society of Chemical Industry, the Priestley Medal of the American Chemical Society in 1948, and the Naval Ordnance Development Award in 1947.

Dr. Weidlein will remain on the board of trustees of the Institute and will be available in an advisory capacity in the administration of the Institute's research programs. His successor has not yet been announced.

New Phillips Black Plant

Phillips Chemical Co., Bartlesville, Okla., will construct a new 64,000,000-pound-capacity carbon black plant in the Gulf Coast area, according to K. S. Adams, chairman of the board. The plant will produce Philblack O and Philblack I.

The location of the proposed plant in the vicinity of existing petroleum processing facilities in the Gulf Coast area, Mr. Adams stated, takes into account the necessary factors of feedstock and adequate water, rail, and truck transportation facilities.

The company's carbon black facilities near Borger, Tex., have a yearly capacity of 290,000,000 pounds and are said to be the world's largest.

ADL Acquires Miner Labs

Arthur D. Little, Inc., Cambridge, Mass., has acquired Miner Laboratories, Chicago, Ill., a chemical consulting firm. The Laboratories has become a division of the industrial research consulting company under the management of John R. Kirkpatrick. Director of technical operations continues to be C. S. Miner, Jr.

The 50-year-old Chicago firm is credited with the development of a method for recovering furfural, a raw material for nylon, from oat hulls and corn cobs. The company was founded by Carl S. Miner, a winner of the Society of Chemical Industry's Perkin Medal.

Imperial Plans Canada Unit

Imperial Paper & Color Corp., Glens Falls, N. Y., has announced plans to manufacture a line of chemical pigment colors in Canada. A subsidiary Canadian corporation is being formed for the purpose and a plant has been purchased at St. Johns, P.Q.

Currently, the company's colors are being marketed in Canada through a subsidiary, Glens Falls Color Export Corp., which covers the Western Hemisphere. The Canadian activity of this subsidiary will eventually be taken over by the new Canadian firm, the company says, but some colors not made in Canada will still be available through the export company.

Houston's Monorail Coach Has 28 Goodyear Tires

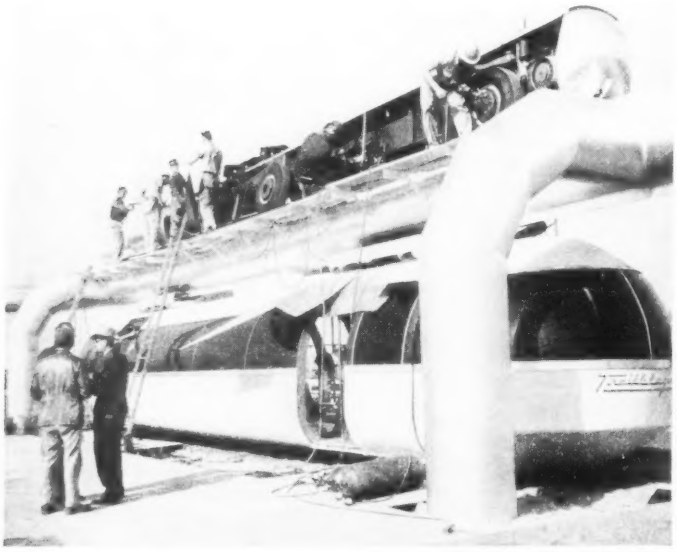
Tires built by The Goodyear Tire & Rubber Co., Akron, O., are being used on the new monorail suspended passenger coach now in operation in a Houston, Tex., park, the company reveals.

Dubbed Skyway monorail by the group of Houston engineers and business men who built and operate the passenger system, the 54-foot blue steel ribbed coach is said to be an improved version of a similar vehicle which for the past 53 years has been operated in Wuppertal, Germany.

The Houston system is a 970-foot freeway with a single steel rail suspended 18 feet above the ground upon which the passenger coach travels. The coach, almost completely encased in fiber glass and solar glass, is powered by two 305-hp. gasoline engines and is said to be virtually noise and vibration free.

On a full-scale line, the system would cost only $500,000 a mile to build, the Houston engineers say, compared to about $5,000,000 for freeways and about $13,000,000 a mile for subways.

There are 28 Goodyear tires on the coach. Eight are 8.25-15 Traction Hi-Miler tires which carry the load and provide the traction, and 20 are 4.00-8 rib trailer tires serving as rail guides.



Workmen installing Goodyear tires on the "power nacelle" unit of Houston's new monorail suspended passenger coach. The coach, now resting on an erected platform, is actually several feet above the ground

Mobay Plans Tripling Size Of New Martinsville Plant

The recently completed isocyanate and polyester plant of Mobay Chemical Co. at New Martinsville, W. Va., is slated for immediate construction work that will eventually triple it in size, David L. Eynon, president of the St. Louis, Mo., firm has revealed.

The plant was finished in February, although some production units were in operation last November. When the new facilities are added, the plant will be the country's largest for the manufacture of isocyanates and polyesters, major components of the new polyurethanes, Mr. Eynon declared.

The expansion move was said to have been prompted by new developments in the United States and abroad which are expected to boost the demand for urethane products faster than was anticipated originally. What the eventual capacity of the New Martinsville plant will be has not been revealed.

According to Mr. Eynon, determining factor in the completion date of the expansion will be availability of construction items. Construction will be done by Blaw-Knox Co., Pittsburgh, Pa., which will also do the mechanical engineering based on what is said to be improved processes developed by Mobay engineers during the last six months.

Observer's declare that the recent entry of the nation's largest chemical producer, E. I. du Pont de Nemours & Co., Inc., into the isocyanate and polyester field may have been one factor spurring Mobay into the expansion move.

Fluorocarbon Colored Inks

Fluorocarbon-type pigmented inks that resist high temperatures and chemicals and can be used for marking the surfaces of many materials that have heretofore resisted inks have been developed by M. W. Kellogg Co., Jersey City, N. J.

The inks are said to adhere to nylon, fluorocarbon and polyethylene surfaces, and many rubbers and plastics, including rigid and plasticized vinyls. They are available as either fully compounded ink concentrates or as a clear vehicle and separate pigment suspensions and can be adjusted in viscosity, drying rate, and color strength to meet individual requirements.

Both air-drying and heat-setting types are being made. Eleven colors are available in the air-drying series, and five colors in the heat-setting series. All of the shades fall within the limits set by MIL-Std.-104. Both types can be applied by standard printing or marking methods, including rubber stamp, silk-screen, offset, and rotogravure.

The heat-setting inks, designed for applications where the inked impression must withstand solvent or chemical attack, can be cured in a hot air oven, with infrared radiation, or by direct application of a hot iron. Setting times are low. The conductive silver formulation is said to be especially suitable for printing electronic circuits on Kel-F plastic film and molded sheet.

The properties, methods of application, and uses of these inks are described in a four-page brochure available from the company on request.

Pennsalt Plans Expansion

Pennsylvania Salt Mfg. Co., Philadelphia, Pa., has filed a registration statement with the Securities & Exchange Commission covering the proposed offering of a new issue of $15,000,000 sinking fund debentures, due April 1, 1981.

According to the company, net proceeds of the sale will be used in a $55,000,000 expansion program spread over the next five years. The program, called the most ambitious in the firm's 106-year history, will provide for the introduction of products and processes new to the company, as well as for the expansion and improvement of present products.

The company's research budget for 1956 is approximately 40% larger than for 1955. Its research activities are centered at its Whitemarsh, Pa., laboratories.

Naugahyde Contest Is On

A contest for retail-store displays of furniture upholstered in Naugahyde vinyl materials, with three trips to Bermuda or Mexico City as the top prizes, has been announced by United States Rubber Co., New York, N. Y., manufacturer of Naugahyde.

The contest began March 26 and will continue through May 25. To be eligible, a display must be in use for at least one week of this period. Traditional, contemporary, or institutional upholstered furniture may be featured. A photograph of the display will be the basis of judging.

Ten regional winners from across the country will be selected, with three national winners being chosen from this group, one each in the traditional, contemporary, and institutional categories. The winners will be formally announced during the Summer Furniture Show in Chicago, Ill., June 17-19.

Kel-F Elastomer's Purity

Purity and contamination-proof requirements in portions of the Jersey City, N. J., synthetic rubber plant of M. W. Kellogg Co. are so critical, the company says, that "technicians working in the area must wear coveralls and footgear approaching a surgeon's dress for aseptic conditions."

The plant is producing Kel-F Elastomer, a fluorocarbon elastomer. When the material leaves the plant's "polymerizing" units, it is dried and packaged for delivery in dust-free, humidity-and-temperature-controlled chambers, Kellogg reports, adding that "the better the control exercised on the manufacture of a material, the more reproducible are its properties."

Witco Polyurethane Unit

Witco Chemical Co., New York, N. Y., has installed a complete pilot plant for the production of polyurethane foams at the Chicago, Ill., laboratories of its Emulsol Division. The new facilities include a specially designed proportioning-mixing machine.

Witco President Max A. Minnig pointed out, however, that the company does not intend to start commercial polyurethane foam production, but is "interested only in the manufacture of raw materials that will improve the qualities of polyurethane foams."

The company currently makes Witco 77-86, a coupler used in the formation of odor-free polyurethane foams.

WC-Plated Skiving Knives

Plating one side of a rubber-cutting skiving knife with a thin coating of tungsten carbide lengthens the life of the instrument by as much as 15 times, it has been reported by Linde Air Products Co., division of Union Carbide & Carbon Corp., New York, N. Y. The company has dubbed the technique "flame-plating" and is offering the service to users of skiving knives.

Skiving knives have a bevel on one side of the blade only. The tungsten carbide coating is applied to the unbeveled side. As the softer, steel base wears more rapidly than the hard, tungsten carbide coating, a sharp edge is always presented to the material being cut, the company explained.

Hetron Sales Are Shifted

Hooker Electrochemical Co., Niagara Falls, N. Y., has made its Durez Plastics Division sales department responsible for sales of Hetron polyester resins, in addition to the Durez line of phenolic resins and molding compounds, according to Robert E. Wilkin, vice president and director of sales. The Hetron sales group has been transferred from Niagara Falls to the division's North Tonawanda, N. Y., offices.

Charles Y. Cain, former manager of plastic sales, has been appointed Hetron sales manager.

The transfer of Hetron sales representative Robert J. Entenman from Niagara Falls to Cleveland, O., was also announced.

ON HIS NINETY-FIFTH BIRTHDAY, last month, Godfrey Lowell Cabot, *right*, chairman of the board of Godfrey L. Cabot, Inc., Boston, Mass., sits at his desk reading congratulatory messages from his friends and associates throughout the world. Owen J. Brown, Jr., company vice president and director of sales, is at left.

New Plaskon Sales Units

Two new district offices for the sale of Plaskon industrial resins have been opened by Barrett Division of Allied Chemical & Dye Corp., New York, N. Y., it has been revealed by Carleton Ellis, Jr., the company's director of plastics and resins sales.

The new offices will be located in New York, N. Y., and Detroit, Mich. W. H. Hough will head the New York office, which will serve New England, the Middle Atlantic States, West Virginia, and eastern Ohio. J. N. Grove will head the Detroit office, which will serve Kentucky, Michigan, western Ohio, and the Mississippi Valley states.

Minnesota Rubber Expansion

A $500,000 plant addition is being constructed by Minnesota Rubber & Gasket Co., Minneapolis, Minn., which will increase its present facilities by about 32,000 square feet. The structure will consist of a production area, new offices, and a research and engineering laboratory. Completion of the three-story brick and concrete building is expected by July.

Robert W. Carlson, vice president and general manager of the firm, said that the laboratory and research center will help keep the company abreast of new developments in rubber materials and to increase their value to industry.

U. S. Rubber Warehouse

United States Rubber Co., New York, N. Y., has begun construction of a new branch office and warehouse on Route 128 in the Dedham-Westwood industrial area to replace its New England servicing facilities in downtown Boston.

Completion of the project is expected by September.

Chester J. Noonan, vice president, director, and member of the executive committee of the company, told a ceremonial luncheon gathering that a 15-20% increase in U. S. Rubber's Boston branch sales is expected for 1956. He also expressed optimism for New England's economic future.

The new warehouse will contain 93,600 square feet of space, and the office area 12,600 square feet. A four-car siding of the New York, New Haven & Hartford Railroad, furthermore, will serve this warehouse.

Firestone Butadiene Plant

A 40,000-ton-capacity butadiene manufacturing plant will be the first unit of a petrochemicals producing center to be built by The Firestone Tire & Rubber Co., Akron, O., on a recently purchased 1,000-acre tract of land in Orange, Tex., it has been revealed by Harvey S. Firestone, Jr., board chairman.

The butadiene plant will provide the company with a "substantial" portion of the butadiene requirements of its synthetic rubber plants at Lake Charles, La., and Akron. Butane, principal raw material of butadiene, will be piped into the plant from various Texas sources.

The new plant will be located in the industrial area southwest of Orange and will employ more than 300 people. Facilities for the production of other as yet unspecified petrochemicals will be built later.

Start of construction is scheduled for May.

Expect Wide Auto Use of Rubber-Nylon "Air Spring"

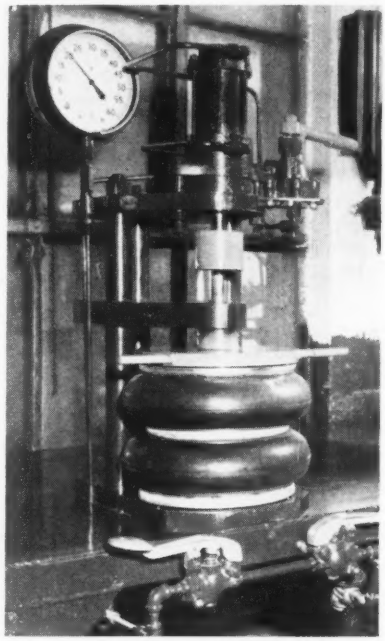
Air springs made of rubber and nylon bellows that provide a new suspension system for vehicular bodies are being widely adopted by manufacturers of buses and lightweight trains and are expected to find application in automotive design in the near future, according to The Firestone Tire & Rubber Co., Akron, O., producer of the air springs.

The springs were developed at the company's Noblesville, Ind., plant and are being made there. They effect smoother riding, less driver and passenger fatigue, quiet operation and easy maintenance, and a fixed height of the vehicle no matter how heavy the load, Firestone declares.

The air spring system includes a metal air tank and self-regulating valves and encloses a variable volume of air. This system also provides a cushion for shocks and vibrations, similar to that of a tire, which the air spring resembles. Two or three rubber and nylon containers are joined to form each air spring. The springs are installed two or four to an axle and are interconnected by the system of valves and air tanks.

The company made its first springs in the early 1930's, which were installed on some custom-made cars. Subsequently installations based on the air spring system have been used on truck trailers, aircraft landing gear, anti-aircraft guns, as well as on buses and trains.

Among the companies that have introduced or plan railroad equipment on air springs, Firestone lists General Motors Corp., Budd Co., Pullman-Standard Car Mfg. Co., ACF Industries, Inc., and General Steel Castings Corp.



Newly built Firestone "air spring" being tested in air-pressure machine

Ball Bros. Buys Rights to Electronic Weighing Device

What is called a "revolutionary" electronic weight and force indicating device has been bought by Ball Brothers Co., Inc., Muncie, Ind., from its developer, Control Cells Corp., Boulder, Colo. The instrument measures weight electrically instead of by springs and balances as in conventional scales.

The Indiana rubber and plastics firm will have exclusive manufacturing and sales rights to the device, which will be made at Boulder by a newly organized Control Cell Division of Ball Brothers, with E. S. Stafford, president of the former Control Cells Corp., as general manager.

The new weighing device is said to be small and compact, but with a practically unlimited weighing capacity. It operates on the principle that the flow of electricity through coils is altered as force or weight is applied, and the degree of change is registered as pounds on a calibrated dial.

The instrument may be adapted to fixed installations or may be used as a portable weighing device. According to Ball Brothers, United Airlines has already put the instrument to use to check load limits and to assure proper distribution of loads on its transport planes. The Indiana Toll Road, now being built, will also use it at vehicular weighing stations.

In portable use, the instrument may be powered by an automobile lighter. Some highway patrols, the company says, are using a "pancake" version to spot-check vehicles for overloading. Adoption of the electronic weighing device is expected in many industries.

Moving Fiber Sales Office

The textile fibers department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., will establish an Akron, O., sales office which will specialize in fiber sales to the rubber industry. The present Wilmington office will be dissolved when the new office has been opened.

Du Pont said the transfer of the office is designed to locate a major segment of its textile fibers sales management in the field and place additional sales help where it is needed.

Howard P. Brokaw, formerly assistant manager of industrial sales, will become regional manager at the new office.

Monsanto in Spanish Move

An agreement providing for acquisition of an equity interest in Etino-Quimica, S.A., Barcelona, Spain, in return for the investment of machinery, equipment, and technological aid by Monsanto Overseas, S.A., has been announced by Marshall E. Young, Monsanto Chemical Co.'s vice president and general manager of its Overseas Division.

Etino-Quimica currently has plant facilities at Monzon, Spain, for the production of polyvinyl chloride. The agreement with Monsanto provides for the expansion of the polyvinyl chloride facilities and the building of polystyrene production facilities. Work to accomplish both projects is now under way.

The completion of the polystyrene facilities will make Etino-Quimica the first producer of the plastic in Spain, Mr. Young said.

New Columbian Akron HQ

Columbian Carbon Co., Akron, O., has begun construction of its new headquarters there, a $150,000 office-laboratory building at 452 E. Market St. The move is said to be part of an overall expansion program undertaken since the company assumed the sale of its own products last July.

The building will occupy about 5,000 square feet on a half-acre plot of land and will house Columbian's area sales and technical staffs. It will be headquarters for servicing all rubber plants between the Mississippi and the New York area.

The company is also constructing a carbon black headquarters in Monroe, La., which will include administrative offices, control laboratories, and engineering department facilities.

Skin Diseases Surveyed

The highest incidence of occupational skin disease in American industry takes place in the manufacture of synthetic resins, chemicals, and dyes, according to Louis Schwartz, retired medical director of the United States Public Health Service.

Dr. Schwartz also listed the manufacture of petroleum products and greases, alkalies, cement, solvents, rubber and its compounds, and paints as producing a high rate of skin disease. These findings were based on a survey personally conducted by Dr. Schwartz.

The best protection against plant irritants was said to be protective clothing made of natural and synthetic rubber or of certain plastics. Protective ointments, easily dispensed from collapsible metal tubes, were also praised.

Believes in Rubber Roads

John L. Cohill, assistant to the president of The Firestone Tire & Rubber Co., Akron, O., told the seventeenth Highway Conference at Salt Lake City, Utah, that rubber will eventually be used in the construction of highways throughout the world.

The Firestone executive said that research conducted by his company had indicated that the use of rubber in asphalt increased the life of highways and cut maintenance costs.

Forty-two test installations of rubberized asphalt have been laid by the company during the last eight years.

Appoint Exposition's Panel

Appointment of a 12-man advisory committee for the ninth National Chemical Exposition to be held in the Cleveland Public Auditorium, Cleveland, O., November 27-30, has been announced by R. L. Savage and A. E. Schneider, joint chairmen of the Exposition committee.

The advisory committee consists of the following: Allen Abrams, The Marathon Corp.; Lawrence Flett, National Aniline Division, Allied Chemical & Dye Corp.; Robert C. Hienton, Cleveland Electric Illuminating Co.; Sidney D. Kirkpatrick, McGraw-Hill Publishing Co.; Carl S. Miner, the Miner Laboratories; Walter J. Murphy, American Chemical Society Journals of Applied Chemistry.

Also George L. Parkhurst, Standard Oil Co. of California; Thomas F. Patton, Cleveland Chamber of Commerce; Raymond Stevens, Arthur D. Little, Inc.; Ernest H. Volwiler, Abbott Laboratories; J. C. Warner, Carnegie Institute of Technology and president of the American Chemical Society; and Clyde E. Williams, Battelle Memorial Institute.

This year's National Chemical Exposition is being sponsored jointly by the Cleveland and Chicago sections of the American Chemical Society.

Rubarite Moves HQ From Chicago to Tulsa

Rubarite, Inc., has moved its general offices from Chicago, Ill., to 1702 Philtower Bldg., Tulsa, Okla. The firm, jointly owned by The Goodyear Tire & Rubber Co., National Lead Co., and Bird & Son, Inc., has its manufacturing plant at Malvern, Ark.

To serve Midwest users of Rubarite, George W. Higgins, a company industrial sales engineer, has opened a new office at 5305 Hohman Ave., Hammond, Ind., according to Emil R. Albert, Jr., Rubarite's president and general manager.

Bag for Synthetic Rubber

A new three-ply, pasted multiwall paper bag with square ends for the packaging of synthetic rubber has been developed by St. Regis Paper Co., New York, N. Y. The bag can be sealed automatically through the use of a bale-closing machine that can handle the production of four rubber manufacturing lines, the St. Regis company says.

The bag is said to have replaced the firm's previous design, a regular sewn multiwall bag with a clay-coated inner ply, which proved disadvantageous in that some rubber often remained wedged into the sewn corners. It is claimed that the new bag does not present this problem.

Described as "box-end," the new bag is available in two forms: coated with a double-weight clay release medium for packaging talc-covered bales, and uncoated for packaging plastic-wrapped bales. After a seven-month test storage period,

Workman stacking synthetic rubber-filled St. Regis Paper bags

the bag exhibited no problems with adhesion, break-through, or contamination of the rubber, according to the company.

Elastomer's Foam Process Licensed to Foreign Firms

Seven European firms have been licensed by Girdler Co., Louisville, Ky., to use the Elastomer process for the production of vinyl foam. The process employs inert gas, rather than a chemical blowing agent, to make vinyl foam and was developed by Elastomer Chemical Corp., Newark, N. J. Girdler is the exclusive licensor of the new process in all foreign countries except Canada.

The new licensees are Les Etablissements Marechal, Paris, France; Le Laboureur, Roubaix, Wattrelos (Nord), France; Svenska Gummifabriks Aktiebolaget, Gislaved, Sweden; Dunlop Rubber Co., Ltd., London, England; Dunlopillo G.M.B.H., Hanau am Main, Germany; British Geon, Ltd., London; and Elson & Robbins, Ltd., Long Eaton, Nottingham, England.

According to Girdler, all major rubber companies in the United States, and some large vinyl processors, have also acquired licenses to produce vinyl foam by the Elastomer process and are tooling up for large-scale operations. Girdler will sell these firms its Votator apparatus for foaming plastisols and its Thermex high-frequency apparatus for electronically fusing the product.

The vinyl foam produced through the Elastomer process is said to be the only type of foam that can be economically heat-sealed electronically to vinyl films, fabrics, and other materials. This foam will not support combustion and can be molded with cores and in contoured shapes, it is further claimed.

Tire Men in Vehicle Check

Representatives of five major tire manufacturing companies will serve as field personnel on the Inter-Industry Highway Safety Committee in that organization's 1956 Vehicle Safety-Check program, conducted nationally each May to encourage motorists to have their vehicles checked for safe operation.

The tire representatives are Edward D. Burks, The Firestone Tire & Rubber Co.; Forest R. Eyer, The General Tire & Rubber Co.; Carl E. Albaugh and Ernest F. Bognar, The B. F. Goodrich Co.; Thomas S. Woods, 3rd, The Goodyear Tire & Rubber Co.; and Norbert J. Griffin, United States Rubber Co. Director of field services for the Committee is Francis P. Lowrey.

The items included in the Vehicle Safety-Check are brakes, front and rear lights, steering, tires, exhaust system, glass, windshield wipers, rear view mirror, and also the horn.

Approve Opalon ACT Cable

Armored cables insulated with electrical-grade Opalon vinyl chloride have been evaluated and approved by Underwriters' Laboratories, according to Monsanto Chemical Co., Springfield, Mass., whose plastics division produces Opalon.

The cables were of the ACT (armored cable, thermoplastic) type, of which the thermoplastic insulation was found to comply with the Type T requirements of the National Electrical Code. Prior tests with other types of thermoplastic insulation had not received recognition by Underwriters' Laboratories.

The ACT-type cables were developed and submitted by Columbia Cable & Electric Corp., Clifton Conduit, Inc., and Ettco Wire & Cable Corp. The companies worked in cooperation with Monsanto's plastics division.

Individual conductors in the new cables are wrapped with 30-pound, wax-impregnated Kraft paper, applied with an overlap of about 50%. Each cable contains an aluminum bonding strip.

Rohm & Haas Patent Suit

Rohm & Haas Co., Philadelphia, Pa., has filed a declaratory judgment suit against General Mills, Inc., Minneapolis, Minn., asking that the Terry & Wheeler Patent, United States patent No. 2,559,-177, assigned to General Mills, be declared invalid.

Asserting that the patent was injurious to Rohm & Haas and to its customers in the vinyl industry, Louis Klein, vice president of the company, said that the legal action was taken "in order to settle the patent question and whether the industry must pay royalty on its use of epoxy-plasticizers."

During the period of litigation, Rohm & Haas will hold harmless its customers for any infringement of this patent by the use of Monoplex S-70, S-71, Paraplex G-60, G-61, and G-62, Mr. Klein said.

"This assumption of responsibility is applicable to all of these products purchased or used while the suit is pending, from February 14, 1956, until settlement is attained or the court's decision becomes final," he concluded.

Forecasts 1956 for F-B

Franklin Farrel, 3rd, president of Farrel-Birmingham Co., Inc., Ansonia, Conn., expects his company to do a high volume of business during 1956, but netting only a narrow margin of profit. The forecast was made during the firm's annual stockholders' meeting, March 15.

The machinery company executive said that for the first two months of 1956, bookings continued to increase; unfilled orders at the end of February were represented by the figure of $44,500,000, as compared to $24,042,000 last year. Competition and higher costs, however, have continued narrow profit margins, he added.

Austin Kuhns, vice president and chairman of the company's finance committee since 1946, was named senior vice president.

All officers of the firm and all members of its board of directors were reelected.

Bearfoot Board Reelected

The reelection of its entire board of directors has been reported by The Bearfoot Sole Co., Inc., Wadsworth, O. The reelected board consists of I. B. Calvin, president; T. D. Calvin, executive vice president; C. E. Chandler, vice president; L. E. Hardwick, sales manager; and J. M. Calvin Hewett, Robert C. Brouse, and E. E. Calvin.

Added to the board were Homer Beaver, vice president in charge of production; and Edward Gulbis, vice president in charge of research and development.

The company reported that it had reached a new high in sales volume during 1955.

Witco Sells Oil, Gas Wells

Witco Chemical Co., New York, N. Y., has sold all of its oil and gas producing properties, according to Board Chairman R. I. Wishnick, "because they did not logically fit in with our plans for continued growth and expansion in the chemical field."

Fifteen of the total of 25 oil and gas wells were sold to Producing Properties, Inc., Dallas, Tex., for about $1,750,000. These were formerly owned by Witco Oil & Gas Co., a wholly owned Witco subsidiary. The selling price of the remaining ten wells was not revealed.

The company will use the proceeds of the sale for "a long-range chemical expansion program," Mr. Wishnick said.

Ridacto Firm Incorporates

Spencer Products Co., Ridgewood, N. J., manufacturer of Ridacto accelerator-activator, has become a corporation, it was announced by C. R. Johnson, president and treasurer, and Spencer Johnson, vice president.

No organizational change in the manufacture or sale of Ridacto, the company's chief product, is contemplated.

C. R. Johnson

Spencer Johnson

The firm's recently established research laboratory is broadening its work in the development of several specific materials for the rubber and plastics industries.

Truck Rim Resins Plating

A process for coating truck rims with epoxy resins instead of the conventional zinc plating has been developed by Firestone Steel Products Co., Akron, O. The new technique is said to protect the rims from corrosion due to water and road salts and to improve the abrasion resistance of the rims.

Designated "perma-plating," the dip process insures uniformity of coating, according to L. J. Campbell, company president, as opposed to the zinc electroplating process where "it was impossible to deposit zinc in uniform thickness on both the rim flange and base."

The process is said to have taken three years to develop. Six epoxy resins were tested before the optimum formulation was selected.

Esso Refinery Will Expand

New ethylene and butadiene facilities have been included in a $40,000,000 expansion and modernization program of its Baton Rouge, La., refinery by Esso Standard Oil Co., New York, N. Y. The refinery is said to be the largest in the country.

Construction of some of the new facilities has already begun. Completion of the entire project is expected in about two years.

The program will also include facilities for increasing aviation gasoline production; lubricating oil, wax, and shipping facilities; and improvements to refinery utilities.

In making the announcement, H. J. Voorhies, Esso vice president and general manager at Baton Rouge, said that the ethylene and butadiene projects "emphasize the growing importance of chemicals from oil and represent another step in the Baton Rouge refinery's continuing program to keep pace with the latest developments."

New Arizona Chemical Lab

A new process development laboratory at Panama City, Fla., has been established by Arizona Chemical Co., New York, N. Y., for expanded research on the firm's tall oil and sulfate turpentine distillation products.

The laboratory will work in conjunction with the Stamford, Conn., laboratories of American Cynamid Co., co-owner with International Paper Co. of Arizona Chemical.

Richard Herrlinger, formerly a research chemist with American Cyanamid, has been named chemical director of the new laboratory and chemical supervisor of the company's plants there.

Also transferred from the Stamford laboratories are Hans Albrecht, a research chemist, and Leo Ciesielski, a chemical engineer. The new facilities will be under the direction of C. J. Kirkland, production manager.

Alco Oil Firm Purchased

Alco Oil & Chemical Corp., Philadelphia, Pa., 28-year-old manufacturer of latex chemical compounds, has been purchased by a group of Cleveland investors for an undisclosed sum. The firm's annual sales volume has been reported at about $5,000,000.

Alco operates two plants in Philadelphia and has warehouses and sales offices in New England, California, and in Akron. Its latex compounding materials are said to go into such products as automotive upholstery, carpets, and foam rubber. It also makes synthetic stabilizers, accelerators, synthetic soaps, and wetting agents.

New officers of the company are William H. Coleman, chairman; Tinkham Veale, II, president and treasurer; and A. A. Augustus, secretary. Arthur E. Jones, a founder of the company, continues as vice president. Mrs. Edna M. Jones, formerly secretary, has been named assistant treasurer.

William L. Lasser

Charles Meyer Studios

D. F. Behney

James L. Weaver, Jr.

Industry Code to Oversee Plastic Water Pipe Output

An identification program "that will assure the public of a safe, uniform quality in plastic pipe for use in systems transporting drinking water" has been developed jointly by the Society of the Plastics Industry, Inc., New York, N. Y., and the National Sanitation Foundation, University of Michigan.

Research into such uses of plastic piping was begun by the SPI more than three years ago. Twenty-two test samples were selected for study, including materials made of polyethylene, polyvinyl chloride, rubber modified polystyrene, and cellulose acetate butyrate. Approved piping must now bear the seal of approval of the National Sanitation Foundation.

According to the SPI, the tests were designed to show "whether or not any substance that might be deleterious to health would be extracted from plastic by an aggressive potable water, and if the passage of water through plastic pipe would affect the appearance, odor, or taste of the water."

The SPI is currently sponsoring a long-term program to develop performance characteristics and test procedures involving plastic pipe. The Society is also working on pipe standards. The cost of these research programs are underwritten by SPI's member companies in the thermoplastic pipe and materials supplying fields.

Manufacturers making plastic pipe bearing NSF approval will be subject to plant inspection and surprise sampling of output. All new materials for potable water transportation must pass NSF tests if they are to receive the Foundation's seal of approval.

Hooker Electrochemical Co., Niagara Falls, N. Y., is making available in research quantities four chlorofluorocarbons. They are 2,3-dichlorohexafluorobutene-2; 1,2-dichlorohexafluorocyclopentene-1; 2,2,-3,3-tetrachlorohexafluorobutane; and 2,2,3-trichloroheptafluorobutane.

Behney, Two Others Named to Harwick Board

D. F. Behney, James L. Weaver, Jr., and William L. Lasser have been elected to the board of directors of Harwick Standard Chemical Co., Akron, O. Mr. Behney was also named vice president in charge of sales.

Previous to joining Harwick in 1950, Mr. Behney was purchasing agent for Goodyear Synthetic Rubber Corp. and a buyer in Goodyear's chemical division. He became general sales manager for Harwick in 1951. He is a former chairman of the Akron Rubber Group.

Mr. Weaver became associated with Harwick in 1947 as procurement expediter and later was named assistant to the treasurer. With his election to the company board he assumes the post of assistant treasurer.

Mr. Lasser started with the firm in 1951 as assistant warehouse superintendent. He now will act in an official capacity in the field of chemical products procurement.

Poll Truck Tubeless Users

Reports from 18 trucking companies who have been using tubeless truck tires for about a year reveal that the tires effect economies in time and money, according to W. E. Lyon, director of tire engineering and development, Firestone Tire & Rubber Co., Akron, O.

The nationwide survey was conducted by Firestone engineers. The trucking firms questioned carried a wide range of liquid and solid cargoes. These firms were all said to be placing or had placed orders for tubeless tires on new equipment.

Mr. Lyon stated that all reports emphasized that tubeless tire mileage was better than or as satisfactory as mileage of conventional tires and tubes. Road delays and punctures were said to have been greatly reduced or practically eliminated, riding qualities of trucks improved, and payloads increased.

Urges Scientists to Enlist Youth into Technical Work

John R. Hoover, president of B. F. Goodrich Chemical Co., Cleveland, O., has called upon American scientists to encourage young people to enter scientific and technical fields.

Speaking to a meeting of the Commercial Chemical Development Association, New York, N. Y., the Goodrich executive said that "the chemical industry cannot continue to build by technology alone, nor by commercial development, nor by investing in new and bigger plants." The one essential ingredient, he declared, was the individual.

"In our great concern with things and dollars, with facts, figures, estimates and potentials, in our preoccupation with plans, we sometimes forget the essential ingredient, people. In our devotion to molecules we may forget men."

He urged that each scientist draw on his own experience to help tell the youth of today that no field in modern times will offer a greater opportunity or a more exciting challenge to their imagination and effort than the taming of nature's molecules to meet the ever-growing needs and wants of men.

"Certainly if industry is a function of research and development, then our national strength and prosperity will be dependent in large measures upon our technological strength and vigor," Mr. Hoover declared.

In reviewing the progress of the chemical industry, he said that the industry had grown to an annual sales volume of $23 billion in 1955 and now directly employs more than 825,000 persons. Investments in chemical plants and equipment exceeded $10 billion during the past 10 years, he added.

General Aniline & Film Corp., New York, N. Y., will erect an $8,000,000 ethylene oxide and ethylene glycol plant at the Linden, N. J., facilities of its dyestuff and chemical division

News About People

Frank E. Harper has been named manager of the Los Angeles, Calif., plant of The B. F. Goodrich Co., Akron, O., succeeding **J. F. Sweatt,** who has retired. **J. A. Sharkey** has been advanced to plant production superintendent there, and **J. Terry Taylor** and **David L. Haines** have been made manager of fuel cell operations and technical manager of fuel cell design and engineering, respectively.

Arthur R. Cutcliff has joined Parker Appliance Co., Cleveland, O., as sales engineer.

John B. Moore and **Edward W. Sullivan** have joined the service engineering staff at the Philadelphia, Pa., sales office of Wheelco Instruments Division, Barber-Colman Co., Rockford, Ill. **James T. Shelton** and **Walter Gilmore** have been named service engineers at Wheelco's Buffalo and New York offices, respectively.

Harold Reuben has been appointed chief chemist of Ace Rubber Products, Inc., Akron, O.

R. D. Glenn has been advanced to assistant works manager for Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. Also advanced were **F. H. Belden** and **R. C. Hieronymus,** to general superintendent and superintendent, respectively, of the company's South Charleston, W. Va., plant.

C. Lynn Frost has been appointed Chicago regional sales manager of the foam products division of Hewitt-Robins, Inc., Stamford, Conn.

Arthur C. Treece has been promoted to general manager of the plastics department of General Electric Co., Decatur, Ill. **John L. McMurphy,** formerly general manager of the plastics department, has been named manager of a special study-team on the insulation businesses of G-E's chemical and metallurgical division.

William Duffy has been appointed chief plant engineer of Stokes Molded Products Division of Electric Storage Battery Co., Trenton, N. J.

Albert H. Cooper, educator and authority on organic and inorganic chemicals, has joined American Hard Rubber Co., New York, N. Y., as assistant to the director of research and development.

Foster Dee Snell, president of Foster D. Snell, Inc., New York, N. Y., has been named representative of the United States on the Water, Sewage & Sanitary Wastes Division of the Applied Chemistry Section, International Union of Pure & Applied Chemistry.

R. L. Stout has been advanced to the position of assistant to the director of sales at the Bound Brook, N. J., plant of American Cyanamid Co., organic chemicals division, New York, N. Y.

Forrest E. Phillips has been promoted to sales manager of the phenolic molding compound department of Synvar Corp., Wilmington, Del.

R. L. Duncan, F. J. Rauscher, and **E. R. Young** have been appointed assistant sales managers for Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y.

Kenneth R. Huffman has been appointed assistant controller of The B. F. Goodrich Co., Akron, O. He has been with the company since 1919.

Robert O. Sauer has been appointed vice president in charge of research and development at Velsicol Chemical Corp., Chicago, Ill. He was formerly engaged in development engineering work with the silicone products department of General Electric Co.

Robert O. Sauer

J. Terry Taylor has been appointed manager of fuel cell operations for the aeronautical products manufacturing department of The B. F. Goodrich Co. Tire & Equipment Division, Akron, O. He will be stationed at the company's Los Angeles, Calif., plant.

Harry J. Karakas has been appointed manager of the process equipment division of Rodney Hunt Machine Co., Orange, Mass.

John J. Hartz has been appointed development manager for all tire manufacturing divisions of The Goodyear Tire & Rubber Co., Akron, O. His career with Goodyear has included 16 years of compound development work in tires, tubes, and accessories.

Leonard Harral, a pioneer in latex foam manufacture, has retired from his directorship of the Dunlopillo division of Dunlop Rubber Co., Walton, Liverpool, England. He is a former chairman of the British Latex Foam Manufacturers' Association.

Robert N. Rylands has been promoted to production manager of the Akron, O., Plant 3 of B. F. Goodrich Chemical Co., Cleveland, O. He joined Goodrich in 1941.

William B. Wiegand, director and research consultant of Columbian Carbon Co., New York, N. Y., has been awarded a Master of Arts degree by the department of Greek and Latin of Columbia University.

Robert U. Haslanger has been elected vice president and general manager of Escambia Bay Chemical Corp., Cambridge, Mass.

Lawrence P. Thies has been assigned as special representative to the Cleveland district for the chemical division of The Goodyear Tire & Rubber Co., Akron, O.

Lawrence P. Thies

Underhill Studio

J. E. Shand

John C. Esher

Louis Miller Sherman

John C. Esher has been appointed assistant sales manager, chemical sales department, for Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. **J. E. Shand** has been named assistant to the department's manager.

Fred C. Hands, formerly manager of B. F. Goodrich Chemical Co.'s Plant 3 in Akron, O., has been named manager of the Institute, W. Va., synthetic rubber plant of Goodrich-Gulf Chemicals, Inc., Cleveland, O. Mr. Hands joined Goodrich in 1935 as a laboratory assistant and was transferred to Plant 3 in 1938, where he was successively named technical supervisor, shift foreman, general foreman, and production manager. He became plant manager in 1948.

John C. MacKinnon has been appointed manager of footwear for Hood Rubber Co., division of The B. F. Goodrich Co., Watertown, Mass.

Anthony G. Tappin, Justin A. Lewis, and **Gil W. Lewis** have been advanced to New York, Cincinnati, and Philadelphia district sales managers, respectively, for the Westvaco Mineral Products Division of Food Machinery & Chemical Corp., New York, N. Y. **Raymond C. Tower** has been appointed product manager of phosphate sales for the Division; while **John M. Richard** has been named product manager of chlorine and alkali sales. **Robert E. Cochran** has been made sales representative to the New Jersey area.

Fred L. Hopper has been made director of tire production planning and distribution for The Firestone Tire & Rubber Co., Akron, O. Among the positions he has held since joining the company in 1933 are operating manager of Plant One and Plant Two and tubeless truck tires project engineer.

Jay Cooke has been elected a director of Hewitt-Robins, Inc., Stamford, Conn.

Fred C. Hands

Fred L. Hopper

W. A. Patterson, president of United Air Lines, has been elected a director of The Goodyear Tire & Rubber Co., Akron, O.

Louis Miller Sherman has joined Thiokol Chemical Corp., Trenton, N. J., as manager of market development. During his 25 years in the chemical industry, he has been associated with Ethyl Corp., Chemical Construction Corp., American Cyanamid Co., and E. I. du Pont de Nemours & Co.

R. E. Champe has joined Automotive Rubber Co., Inc., Detroit, Mich., as sales and cost analyst.

Arthur T. Bennett has been named superintendent of the soda products division of Diamond Alkali Co., Cleveland, O., and **Robert A. Springer** has been appointed manager of research, development, and technical service for the soda products division.

Charles L. Holbert has been elected a vice president of H. K. Porter Co., Inc., Pittsburgh, Pa.

General Anthony C. McAuliffe, recently retired from the United States Army, has joined American Cyanamid Co., New York, N. Y., as head of its engineering and construction division and as president of the firm's engineering subsidiary, Chemical Construction Corp.

Herbert E. Silcox, associated with Merck & Co., Inc., Rahway, N. J., since 1942, has been appointed technical director of the firm's chemical division.

F. G. W. King, for the past 20 years technical director of Dunlop Rubber Co., Ltd., Fort Dunlop, England, has retired. He has been credited with many important developments in tire design and manufacture during his long career with the company.

Daniel H. Lipman has been elected a director of Stein, Hall & Co., Inc., New York, N. Y. He is also a vice president and general sales manager of the firm.

Carl E. Huxley

Carl E. Huxley has been named technical sales representative to the West Coast area by the butyl division of Enjay Co., Inc., New York, N. Y., and will be headquartered in the company's Los Angeles, Calif., office.

Jacques P. Sibeud has been appointed manager of laboratories for Rhodia, Inc., New York, N. Y. Dr. Sibeud was formerly associated with Rhone-Poulenc, Paris, France.

Ralph F. Nickerson has been transferred from the research department of the inorganic chemicals division of Monsanto Chemical Co., St. Louis, Mo., to Shawinigan Resins Corp., Springfield, Mass. Succeeding him as group leader of the silica products group is **Harry Teicher.**

George W. Russell has been named general manager, and **Alden R. Loosli** assistant general manager of the industrial chemicals division of American Cyanamid Co., New York, N. Y.

Theodore P. Malinowski has been appointed development manager of the product development department, chemicals division, of Atlas Powder Co., Wilmington, Del.

Carlyle W. Gilbert has been named manager of the resins and plastics department of the chemical plants division of Blaw-Knox Co., Pittsburgh, Pa.

Joginder Lal has been appointed to the diene synthetic rubbers section of the research division of The Goodyear Tire & Rubber Co., Akron, O. Born in India, Dr. Lal received his doctorate from the Polytechnic Institute of Brooklyn in 1951.

Charles O. Koch has joined the development department of Mobay Chemical Co., St. Louis, Mo. He was formerly technical service superintendent at the company's New Martinsville, W. Va., plant.

Larry Jacobson

Larry Jacobson has been advanced to staff assistant, calcium carbonate sales, in the silicate, detergent, calcium division of Diamond Alkali Co., Cleveland, O.

Barrett Kirkendall has been named assistant manager of the central sales division of The Firestone Tire & Rubber Co., Akron, O.

Harry C. Burger has joined Gates Engineering Co., Wilmington, Del., as vice president of operations.

George W. Blackwood has been elected president, and **William L. Taggert, Jr.,** executive vice president of Dewey & Almy Chemical Co. Division of W. R. Grace & Co., Cambridge, Mass.

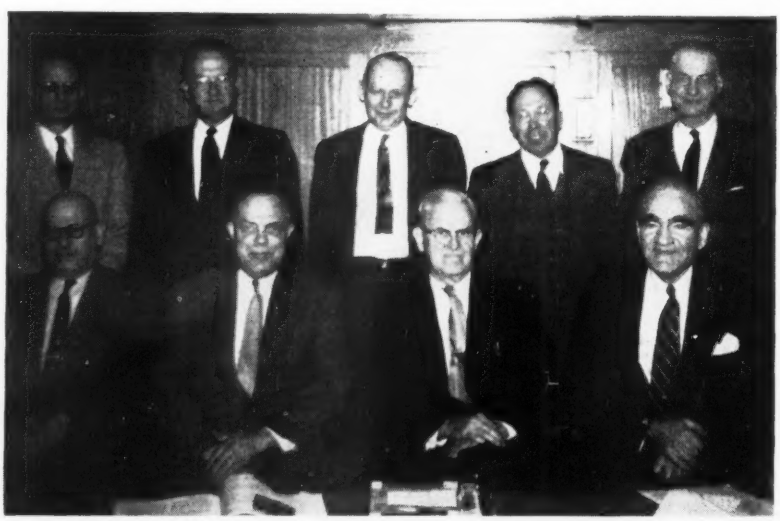
Jacob E. Jansen, associated with The B. F. Goodrich Co., Akron, O., since 1938, has been named director of organic chemicals research at the company's Brecksville, O., Research Center.

Charles Boland Cooper, production manager of B. F. Goodrich Chemical Co.'s Plant 3, Akron, O., has been named plant manager there. He joined Goodrich in 1937.

Earl P. Stevenson has been elected chairman of the board of Arthur D. Little, Inc., Cambridge, Mass., and is succeeded as president of the firm by **Raymond Stevens,** vice president since 1930.

Thomas C. Williams has joined the product development section, silicones division, Union Carbide & Carbon Corp., Tonawanda, N. Y., and will work on silicone rubber. He was formerly chief chemist of Okonite Co.

E. D. Murphy has been appointed manager of sales control for Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. He has been associated with the company since 1925.



John J. Loughlin, Chemists Club (N. Y.)

RUBBER WORLD EDITORIAL ADVISORY BOARD meets with editor at the Chemists Club, New York, N. Y., March 5. Left to right, standing: S. D. Gehman, Goodyear Tire & Rubber Co.; J. H. Fielding, Armstrong Rubber Co.; R. G. Seaman, editor; P. D. Brass, United States Rubber Co.; and J. H. Ingmanson, Whitney Blake Co. Left to right, seated: B. H. Capen, Tyer Rubber Co.; L. H. Howland, Naugatuck Chemical Division, U. S. Rubber; W. E. Kavenagh, Goodyear; and John Ball, Midwest Rubber Reclaiming Co. Two additional members of the Board who were unable to attend this meeting are C. C. Davis, Boston Woven Hose & Rubber Co., and Edwin B. Newton, B. F. Goodrich Co. Research Center

News Briefs

General Electric Co., silicone products department, Waterford, N. Y., has named the Harwick Standard Chemical Co. branch at Albertville, Ala., a distributor for its silicone mold release agents SM-55, SM-61, and SF-96 and its anti-foam materials Anti-foam 60 and SS-66. The area of distribution will be confined to Alabama, Florida, Georgia, Mississippi, and Tennessee.

H. Muehlstein & Co., Inc., has moved its Los Angeles, Calif., offices and warehouse to 4879 E. Fruitland Ave.

Stauffer Chemical Co., New York, N. Y., will acquire West End Chemical Co., Oakland, Calif., which will continue to operate under its present management as an autonomous division of Stauffer.

Columbian Carbon Co., New York, N. Y., will begin construction of a new addition to its North Bend, La., carbon black plant with a rated annual capacity of 20 million pounds. A second unit of equal capacity is being contemplated for the site.

Pennsylvania Industrial Chemical Corp., Clairton, Pa., has opened a new district sales office in the Park Square Bldg., 31 St. James Ave., Boston, Mass.

The B. F. Goodrich Co., Akron, O., reveals that the new $6,000,000 tire plant of Goodrich International Rubber Co. at Marikina, the Philippines, will begin operations before the end of the year. Goodrich, with a minority interest in the Philippine company, will furnish technical and production management.

The C. P. Hall Co., Akron, O., has been named manufacturer's representative for Detero Wax Beads, a product of Arrow Laboratories, Inc., Chicago, Ill., formerly American Maintenance Supply Co.

O'Sullivan Rubber Corp., Winchester, Va., has been awarded a contract by the Philadelphia Quartermaster Depot for the production of 220,000 pairs of U. S. Army rubber soles valued at $112,100.

Food Machinery & Chemical Corp., New York, N. Y., is transferring the research activity of its Westvaco Chlor-Alkali Division to its FMC Chemicals central research laboratory now being constructed at Princeton, N. J. W. L. Davidson, Westvaco's research director, has been named assistant director of the laboratory.

New Jersey Zinc Co., New York, N. Y., will purchase the Gloucester City, N. J., plant of American Cyanamid Co., where it will manufacture titanium dioxide pigments.

The Wooster Rubber Co., Wooster, O., reports a 380% sales gain in its colored plastic-and-fabric Stylemaster Kar-Rugs for automotive interiors since they were introduced in early 1955.

National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y., will build an addition to its research-engineering center at its Buffalo, N. Y., plant which will be devoted mostly to application research on diisocyanates.

Stillman Rubber Co., Culver City, Calif., has acquired Extruded Products Co., Fullerton, Calif. V. L. Neschke will continue as vice president and general manager of Extruded Products in the new divisional setup; Joel Bush has been named vice president in charge of production.

Whittaker, Clark & Daniels, Inc., New York, N. Y., has been appointed sole United States distributor of Reckitt's Seagull Ultramarines, industrial blue colorings, available in a wide range of shades, that are said to be highly stable to light.

Rhodia, Inc., New York, N. Y., has moved into new offices at 60 E. 56th St.

Fred W. Bommer

Harwick Standard Chemical Co. of California, Los Angeles, Calif., celebrated its tenth anniversary at the Ambassador Hotel, Los Angeles, March 9, with Chairman of the Board Virginia L. Harwick in attendance, among others.

California Testing Laboratories, Los Angeles, Calif., has expanded to a new 5,000-square-foot building, enabling it to "provide service to the industry throughout the United States."

Stauffer Chemical Co., New York, N. Y., is building a new 15,000 square foot warehouse for its molded products division in Vernon, Calif., which is scheduled for completion in late summer.

Pawling Rubber Corp., Pawling, N. Y., has been awarded a contract by the Philadelphia Quartermaster Depot for the manufacture of 765,000 rubber service cap crown supports valued at $73,057.50, intended for United States Army procurement.

A. E. Hunt Steel Co., Boston, Mass., New England representative of the Steel and Tube Division, Timken Roller Bearing Co., Canton, O., has sold its warehouse facilities and alloy steel inventories to S A E Steels, Inc., Cleveland, O. As the A. E. Hunt Division, S A E Steels, Inc., A. E. Hunt will continue as Timken representative without change.

General Electric Co., X-ray department, Milwaukee, Wis., has created two separate sections for the marketing of medical and industrial X-ray apparatus. Gordon E. Williams, has been named manager of the medical X-ray marketing section, and Edward W. Philleo has been appointed manager of the industrial X-ray marketing section.

Obituaries

Fred W. Bommer

Frederick William Bommer, chairman of the board of Acushnet Process Co., New Bedford, Mass., died of a heart attack at a New Bedford hospital, February 10.

He was born in Boston, Mass., on May 3, 1889. He attended Massachusetts Institute of Technology, graduating in 1914 with a Bachelor of Science degree in Chemical Engineering.

He joined Boston Woven Hose & Rubber Co. that same year as a management engineer. Later he went to the consulting firm of Stevenson Corp. and through it became associated with Converse Rub-

ber Shoe Co. as plant engineer. Subsequently the deceased became general manager of Lambertville Rubber Co. In 1925 he founded and was president of Arlington Rubber Co.

Then, in the year 1932, Mr. Bommer became associated with Acushnet, organizing its golf ball division. He rose to vice president in charge of the golf ball division and president of Acushnet Process Sales Co., a company subsidiary. He was elected chairman of its board of directors in 1955.

Mr. Bommer was a member of the Wamsutta Club, the Country Club of New Bedford, and the Golf Ball Manufacturers Association.

He is survived by his wife, his mother, a daughter, a son, two brothers, three sisters, and three grandchildren.

Funeral services were held February 14 at Mt. Auburn Chapel, Cambridge, Mass., and burial took place at Mt. Auburn Cemetery.

Joseph D. Sharkey

Joseph D. Sharkey, manufacturers sales manager for The Firestone Tire & Rubber Co., Akron, O., died suddenly February 26 in an Akron hospital following an operation. He was 51.

Mr. Sharkey joined Firestone in 1930 as a salesman in the Milwaukee area, became truck tire representative in Kansas City in 1932 and district sales manager there the following year. He served as Omaha district manager from 1934 to 1938, Chicago district manager until 1945, manager of the Midwest sales division in Akron until 1949, and eastern division sales manager until 1953, when he was named manufacturers sales manager.

The deceased was born and educated in Syracuse, N. Y.

A Requiem Mass was offered on February 29 in St. Vincent's Church, followed by interment in Holy Cross Cemetery.

He is survived by his wife and two sons.

Financial

Allied Chemical & Dye Corp., New York, N. Y., and subsidiaries. For 1955: net profit, $52,127,975, equal to $5.72 each on 9,117,628 capital shares, against $43,071,766, or $4.80 each on 8,981,167 shares, the year before; sales $628,514,087, against $530,776,716; federal income taxes, $41,059,735, against $31,550,699.

American Hard Rubber Co., New York, N. Y. Year to December 31, 1955: net income, $952,560, equal to $2.91 a common share, compared with $551,472, or $1.52 a share, in 1954; sales, $22,413,859, against $17,678,982.

American Viscose Corp., New York, N. Y. For 1955: net earnings, $24,709,000, equal to $4.66 a share, contrasted with $10,487,000, or $1.85 a share, in the preceding year; net sales, $259,442,000, against $217,170,000; income taxes, $26,770,000, against $11,615,000.

Armstrong Cork Co., Lancaster, Pa., and domestic subsidiaries. Twelve months to December 31, 1955: net profit, $14,542,289, equal to $2.83 a common share, against $11,913,676, or $2.45 a share, in 1954; net sales, $249,385,639, against $217,557,305; federal income taxes, $15,950,000, against $12,400,000.

Sidney Blumenthal & Co., New York, N. Y. For 1955: net loss, $1,998,375, against net loss of $1,608,327 the year before.

Borg-Warner Corp., Chicago, Ill., and subsidiaries. For 1955: net profit, $41,075,784 (a new high), equal to $5.17 a common share, compared with $24,460,075, or $3.27 a share, in 1954; net sales $552,192,430 (a record), against $380,317,341; provision for income taxes and renegotiation, $43,700,000, against $24,450,000.

Brown Rubber Co., Inc., Lafayette, Ind. January 1-December 31, 1955: net income, $733,628, equal to $1.94 each on 377,818 capital shares, against $521,155, or $1.38 each on 376,638 shares, in the previous year; federal income taxes, $757,500, against $541,000.

Brunswick-Balke-Collender Co., Chicago, Ill. For 1955: net profit, $1,371,771, equal to $2.52 a share, compared with $692,230, or $1.15 a share, a year earlier.

Columbian Carbon Co., New York, N. Y., and subsidiaries. For 1955: net profit, $6,305,977, equal to $3.91 each on 1,612,218 capital shares, compared with $4,558,718, or $2.83 a share, the year before; net sales, $62,781,200, against $52,883,920; income taxes, $3,500,000, against $2,190,000.

Dayton Rubber Co., Dayton, O. Three months to January 31, 1955: net income, $435,833, equal to 60¢ a share, against $416,671, or 67¢ a share, in the corresponding period of 1955; consolidated net sales, $14,740,680, against $14,252,951.

Cooper Tire & Rubber Co., Findlay, O. For 1955: net income, $400,011, equal to $2.55 a share, contrasted with $125,041, or 80¢ a share, in 1954.

Detroit Gasket & Mfg. Co., Detroit, Mich. For 1955: net profit, $2,062,940, equal to $2.65 a share, compared with $941,664, or $1.21 a share, the year before.

Diamond Alkali Co., Cleveland, O., and subsidiaries. Year ended December 31, 1955: net profit, $8,442,908, equal to $3.38 a share, contrasted with $5,528,600 or $2.14 a share, the year before; net sales, $110,292,280, against $93,505,530; federal income taxes, $9,675,435, against $4,863,164.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. For 1955: net income, $292,000,000 (a new high), and equal to $9.26 a common share, compared with $84,000,000, or $7.33 a share, in 1954; sales, $1,909,000,000 (another record), against $1,750,000,000; provision for federal income taxes and renegotiation, $313,000,000, against $258,000,000.

The Eagle-Picher Co., Cincinnati, O. Quarter ended February 29, 1956: consolidated net earnings, $2,424,243, equal to $2.45 a share, contrasted with $706,508, or 71¢ a share, in the corresponding period of 1955; net sales, $29,829,500, against $26,222,019.

Farrel-Birmingham Co., Inc., Ansonia, Conn. Twelve months to December 31, 1955: net earnings, $1,320,386, equal to $4.13 a share, contrasted with $2,646,913, or $8.14 a share, the year before; net sales, $37,852,235, against $40,260,238; federal income taxes, $1,331,000, against $3,305,000; current assets, $19,198,545, current liabilities, $5,913,103, against $18,490,637 and $7,578,161, respectively, on December 31, 1954.

Firestone Tire & Rubber Co., Akron, O., and subsidiaries. Quarter ended January 31, 1956: net earnings, $13,502,300, equal to $1.66 a share, against $10,536,211, or $1.30 a share, in the like period last year; net sales, $264,986,126, against $247,790,647.

Garlock Packing Co., Palmyra, N. Y. For 1955: net profit, $1,622,609, equal to $3.61 a share, compared with $967,186, or $2.31 a share, in 1954.

General Cable Corp., New York, N. Y. For 1955: net earnings, $6,547,588, equal to $2.73 a share, against $5,219,933, or $2.31 a share, in 1954.

Industrial Rayon Corp., Cleveland, O., and subsidiary. For 1955: net income, $10,681,279, equal to $5.77 a share, compared with $7,404,829, or $4.01 a share, the year before; net sales, $83,657,815, against $65,916,451; federal income taxes, $11,450,000, against $7,875,000.

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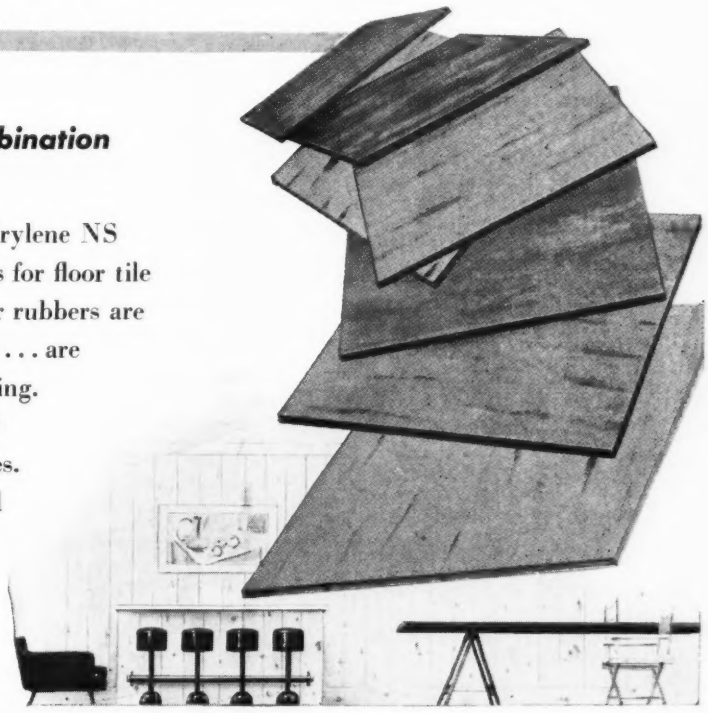

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Glidden Co., Baltimore, Md. Six months ended February 29, 1956: net earnings, $3,635,223, equal to $1.58 each on 2,295,740 common shares; net sales, $107,284,902.

The B. F. Goodrich Co., Akron, O., and subsidiaries. Year ended December 31, 1955: net earnings, $46,662,127, equal to $5.26 a common share, compared with $38,815,737, or $4.40 a share, in 1954; net sales, $755,016,879, against $630,670,600; income taxes, $48,330,000, against $36,474,000; current assets, $350,626,130, current liabilities, $109,474,023, against $319,048,371 and $93,415,617, respectively on December 31, 1954.

Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont., Canada. For 1955: net profit, $4,397,946, equal to $15.96 a share, contrasted with $2,476,961, or $8.48 a share, the year before.

Hewitt-Robins, Inc., Stamford, Conn. and domestic subsidiaries. Year ended December 31, 1955: net profit, $1,338,854, equal to $4.21 each on 301,431 common shares, contrasted with $857,596, or $2.82 each on 287,051 shares, in the preceding year; sales, $47,132,792 (a new high), against $35,588,613; federal income taxes, $1,282,927, against $175,125; current assets, $18,105,715, current liabilities, $7,433,496, against $14,467,378 and $4,563,764, respectively, on December 31, 1954.

Jenkins Bros., New York, N. Y. For 1955: net earnings, $457,911, equal to $3.59 a share, contrasted with $777,991, or $6.10 a share, the year before.

Lee Rubber & Tire Corp., Conshohocken, Pa. Quarter ended January 31, 1955: net earnings, $312,795, equal to 37¢ a share, against $315,718, or 37¢ a share, a year earlier.

Mansfield Tire & Rubber Co., Mansfield, O. For 1955: net earnings, $1,768,203, equal to $3.00 a share, compared with $890,485, or $1.61 a share, in 1954; sales, $74,555,659 (a record), against $50,378,302.

Merck & Co., Rahway, N. J. For 1955: net profit, $15,714,342, equal to $1.40 a share, against $12,614,086, or $1.09 a share, in 1954.

Mohawk Rubber Co., Akron, O. For 1955: net profit, $321,068, equal to $2.27 a share, contrasted with net loss of $646,522 in 1954; net sales $14,330,371, up 62% from the '54 figure; federal income tax, $320,376; current assets, $4,824,297; current liabilities, $1,669,383.

Mt. Vernon-Woodberry Mills, Inc., New York, N. Y. For 1955: net income, $1,250,608, equal to $1.90 a share, compared with $737,754, or $1.13 a share, in 1954.

Minnesota Mining & Mfg. Co., St. Paul, Minn., and domestic and Canadian subsidiaries. Year to December 31, 1955: net profit, $34,323,370, equal to $4.14 a common share, compared with $24,241,885, or $2.95 a share, in the preceding year; net sales, $281,860,717, against $230,890,482; income taxes, $35,200,000 against $24,500,000.

Monsanto Chemical Co., St. Louis, Mo., and consolidated subsidiaries. For 1955: net income, $42,169,970, equal to $1.98 each on 20,998,945 common shares; sales, $522,349,097; provision for income taxes, $36,898,000; current assets, $185,426,924, current liabilities, $50,393,635.

Okonite Co., Passaic, N. J. For 1955: net earnings, $1,559,497, equal to $8.18 a share, compared with $1,171,899, or $6.54 a share, in 1954.

National Lead Co., New York, N. Y. For 1955: net income, $47,889,941, equal to $4.02 a share, against $36,618,651, or $3.05 a share, in 1954.

O'Sullivan Rubber Corp., Winchester, Va. For 1955: net loss, $26,000, compared with net loss of $49,410 in 1954.

Phelps Dodge Corp., New York, N. Y. For 1955: net profit, $72,319,224, equal to $7.13 a share, compared with $41,249,391, or $4.07 a share, in 1954.

Phillips Petroleum Co., Bartlesville, Okla., and subsidiaries. Twelve months to December 31, 1955: net income, $95,203,057, equal to $5.55 a capital share, against $76,234,679, or $5.20 a share, a year earlier; federal income taxes, $41,000,000, against $18,000,000.

Polymer Corp., Ltd., Sarnia, Ont., Canada. For 1955: net income, $7,531,200, compared with $4,924,753 in 1954; net sales, $61,590,151, against $53,228,416; income tax, $6,639,000, against $4,727,000; current assets, $25,562,474, current liabilities, $7,745,346, against $20,194,400 and $4,898,715, respectively, on December 31, 1954.

St. Joseph Lead Co., New York, N. Y. For 1955: net profit, $12,729,820, equal to $4.68 a share, contrasted with $7,523,503, or $2.77 a share, in 1954; net sales, $121,497,456, against $95,003,072; income taxes, $6,478,177, against $4,628,764.

United States Rubber Co., New York, N. Y., and subsidiaries. Year ended December 31, 1955: net profit, $33,559,494 (a new high), equal to $5.24 a common share, compared with $27,958,902, or $4.29 a share, the year before; net sales, $925,539,092 (another record), against $781,574,240; income taxes, $42,452,469, against $26,564,147; current assets, $406,801,892, current liabilities, $147,046,251, against $355,115,281 and $122,667,819, respectively, on December 31, 1954.

Shell Oil Co., New York, N. Y., and subsidiaries. For 1955: net profit, $125,531,950, equal to $4.56 a capital share, against $121,126,546, or $4.41 a share, in 1954; sales, $1,484,069,013, against $1,312,059,959; federal income taxes $68,000,000 against $60,000,000.

Sheller Mfg. Corp., Portland, Ind. For 1955: net profits, $3,754,515, equal to $3.94 a share, against $2,726,698, or $2.86 a share, in 1954.

Skelly Oil Co., Kansas City, Mo. For 1955: net earnings, $32,240,262, equal to $5.61 a share, compared with $29,455,250, or $5.12 a share, in 1954.

Taylor Instrument Cos., Rochester, N. Y. Six months ended January 1, 1956: net earnings, $184,909, equal to 98¢ a share, contrasted with $692,864, or $3.67 a share, a year earlier.

Timken Roller Bearing Co., Canton, O., and subsidiaries. Twelve months to December 31, 1955: net earnings, $22,100,165, equal to $9.13 each on 2,421,380 capital shares, contrasted with $10,658,159, or $4.40 a share, in 1954; net sales, $196,054,414, against $135,551,313; income taxes, $27,648,000, against $11,936,500.

United Elastic Corp., Easthampton, Mass. For 1955: net income, $1,385,208, equal to $3.42 a share, against $1,268,850, or $3.13 a share, the year before.

United Engineering & Foundry Co., Pittsburgh, Pa. For 1955: net income, $2,192,608, equal to 87¢ a share, compared with $2,852,372, or $1.14 a share, in 1954.

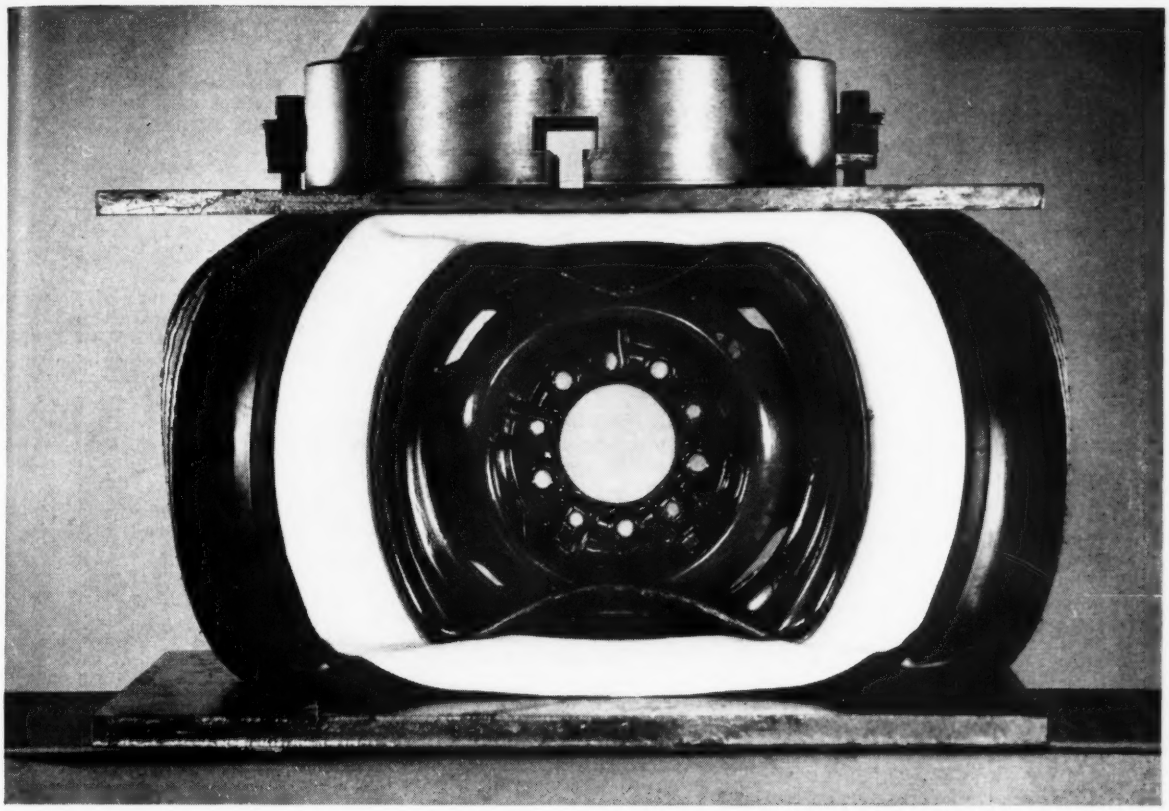
S. S. White Dental Mfg. Co., Philadelphia, Pa., and domestic and Canadian subsidiaries. Twelve months to December 31, 1955: net earnings, $934,154, equal to $2.54 a capital share, compared with $733,756, or $1.99 a share, the year before; net sales, $21,924,036, against $20,280,258; income taxes, $897,000, against $720,000.

Wallace & Tiernan, Inc., Belleville, N. J. For 1955: net profit, $2,455,208, equal to $1.97 a share, against $2,152,428, or $1.72 a share, the year before.

Western Electric Co., New York, N. Y. For 1955: net earnings, $63,339,798, equal to $4.98 a share, against $55,836,430, or $4.83 a share, in 1954.

Westinghouse Air Brake Co., Wilmerding, Pa. Year ended December 31, 1955: net earnings, $12,357,959, equal to $2.98 a share, compared with $7,763,546, or $1.88 a share, in 1954.

Westinghouse Electric Corp., Pittsburgh, Pa. For 1955: net profit, $42,802,747, equal to $2.46 a share, compared with $79,921,732, or $4.78 a share, the year previous.



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News from Abroad

Indonesia

Rubber Goods Production and Consumption

Since no separate rubber statistics are available for the consumption of rubber in Indonesia, F. J. Bruggeman, of J. P. & P. Karet (formerly INIRO) Bogor, has attempted[1] to form an estimate on the basis of figures for imports, local production, and other information. From the data thus obtained, he calculated that annual rubber consumption here is about 16,000 tons, or 0.4-pound per capita, which is little enough when compared with Western countries, but compares very favorably with the 0.2-pound of China and the 0.1-pound of India.

Though admittedly incomplete, the figures on which the estimate is based give a good idea of the trend of imports and the development of the local rubber manufacturing industry in 1953. A comparison with preceding years clearly shows the effect of measures taken to restrict imports in order to encourage local industry. From 1949 up to and including 1952, imports of rubber goods increased steadily; the 1953 figures, however, fell by 50% from the 1952 level; the drop was largely due to the drastic cuts in imports of automobile tires (51,008 units, value 19,884,528 Rupiah, against 156,210 units, value 57,596,776 Rp.); belting (105,324 kilograms, value 2,976,672 Rp., against 180,579 kilograms, value 5,744,462 Rp.); footwear (45,331 kilograms, value 428,489 Rp., against 225,446 kilograms, value 2,037,636 Rp.). Apparently also many miscellaneous rubber items including solid tires, notions, solutions, packing, etc. were not imported in 1953. On the other hand, the 1953 figures for cycle tires were three times higher than in 1952 (727,306 units, value 7,312,795 Rp., against 208,786 units, value 2,342,882 Rp.).

According to Bruggeman's figures, the amounts of some of the more important articles produced locally in 1953 follow:

Auto tires	*no.*	296,700
Tubes	*no.*	277,000
Motorcycle tires	*no.*	12,400
Tubes	*no.*	34,600
Cycles tires	*no.*	3,171,300
Tubes	*no.*	2,815,000
Solid tires	*no.*	237,500
Rubber and fabric shoes and sandals	*pr.*	6,219,000
Other footwear, wholly or partly of rubber	*pr.*	733,000
Soles and heels	*no.*	546,000
Belting	*meters*	83,900
Tubing	*meters*	649,000
Rubberized fabric	*meters*	766,500
Balloons	*no.*	2,500,000

As compared with previous years, these figures, on the whole show an increase in production for 1953; however, some sharp setbacks occurred, especially in the manufacture of belting and tubing, apparently due to poor quality. In the tire branch output of inner tubes for automobiles had been falling since 1951, and the 1953 figures for motor cycle tires were also lower. On the other hand, the manufacture of hospital sheeting and other rubberized fabrics has advanced considerably in the space of three years, rising from 26,994 meters in 1951 to 766,482 meters in 1953.

The manufacturers considered by Bruggeman fall into two classes, those employing more than 50 persons and those employing from 10 to 50 persons. In 1953, there were 39 of the former, employing in all 6,666 persons, against 14, in 1940, employing 3,371 workers. Total earnings in 1953 for workers in these enterprises came to Rp. 21,750,000. Information was obtained also from 37 smaller establishments employing 746 persons.

The larger establishments accounted for all the tires produced (except a small amount of cycle tires), most of the mechanical goods, a substantial part of the footwear, all the rubberized fabric, in addition to various quantities of toys, druggists' sundries, hard rubber goods, and the like. The smaller outfits made all the balloons, some of the footwear, and a number of small items. They have also begun to produce small amounts of foam rubber and foam rubber goods.

[1] *Bergcultures*, Aug. 1, 1955, p. 367.

Report of the CPV for 1954

A summary of the report on the experiment stations of the CPV (General Association of Experiment Stations), Bogor, for 1954, by Director W. C. van Heusden, appearing in *Bergcultures*,[1] reveals some of the difficulties under which experiment stations in Indonesia as well as planters have to operate.

The two chief problems facing the experiment station in 1954 were the turnover in trained personnel and shortage of funds. At the end of the year, the CPV experiment station had a staff of 18 university men and 44 graduates of secondary schools; in addition some 500 workers under 15 supervisors were employed for the eight experimental gardens. Numerically, the staff is adequate, but as a result of frequent changes there is a lack of seasoned research workers; of the university men active at the end of 1954, 60% had had only three years and less of the type of experience required for work on crops in the hill districts. As, moreover, most of those who go on foreign leave—always experienced men—prefer to take positions elsewhere and do not return to Indonesia, the situation tends to become worse; there is no certainty that the existing nucleus of seasoned workers can be retained and, consequently, it becomes less and less possible to undertake long-term research.

Investigation was hampered also by the lack of funds for the purchase of modern equipment and materials. New rulings on foreign exchange and trade in 1954 added to difficulties in acquiring essential laboratory apparatus, glassware, and chemicals, as well as of scientific works and periodicals. Even the importation of fertilizers, insecticides, and fungicides was affected.

On the estates, efforts to combat mildew in West Java were hindered by obstacles in the way of obtaining equipment and because the sulfur was not up to requirements. Again, interest by planters in preparing crepe by new methods requiring oxalic acid and RPA 3,[2] was for a time checked because the necessary chemicals were made too expensive by extra import levies, which, to be sure, were later removed after representations made to the authorities by the General Agricultural Syndicate.

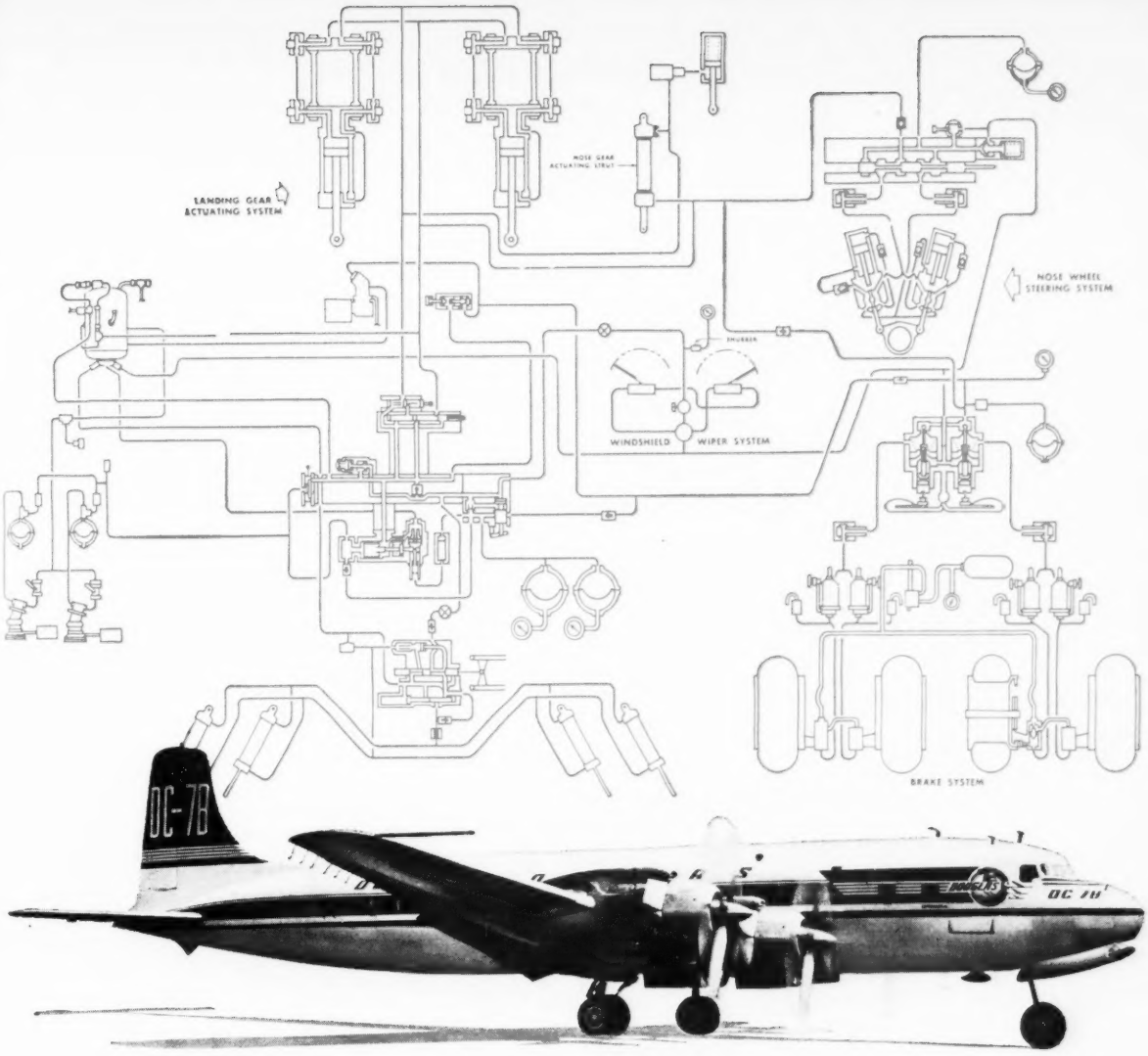
On the other hand, the upkeep and improvement of plantations suffered from a lack of funds and personnel. Rubber output on estates in Java has been declining, the report shows; for approximately the same total area, there was a decrease in yield of about 4% in 1954, as compared with 1953; and average production per hectare fell from 670 kilograms in 1953 to 640 kilograms in 1954. Nitrogen deficiency in the soil in some districts, shortage of supervisors and consequent sub-standard work by tappers and other estate workers, are among the reasons cited for this state of affairs. There is a need of young, high-yielding plantations, but again tight funds and insufficient personnel, as well as the danger of the land being occupied by Indonesians, make many estate owners reluctant to replant.

As a result of arrangements between the experiment stations of CPV and AVROS in Indonesia, and those in Ceylon, Malaya, and Indochina, there has been an interchange of clones, and 20 very promising clones have been obtained from Malaya, a like number from Ceylon, and 40 from Indochina.

Referring to T.C. rubber, the report states that the estates within the sphere of the appropriate section of the CPV produced 11,500 tons of T.C. rubber in 1954, against 6,127 tons in 1953, and almost nothing in 1952. There are indications, however, that the limits of participation in the T.C. scheme have been reached here.

The report concludes by emphasizing that rubber, tea, and coffee, next to copra and tin, still are Indonesia's most important exports, and that research can further enhance their importance. But, it warns, underestimation by those concerned of the basic requisites for good research—keeping the research staff up to standard, insuring a peaceful atmosphere to work in, and making adequate funds available—must lead to a lowering of the quality of work at the experimental stations, to the detriment of the development of local plantation industries as well as to their ability to compete abroad.

[1] July 16, 1955, p. 343.
[2] E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., U.S.A.



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Lower Imports Not Good

In an editorial note *Bergcultures*[1] touches on the general decrease in imports after 1951 and points out that this is not altogether a healthy sign as far as Indonesia is concerned. For various factors seem to have conspired to form a vicious circle whereby both exports, which should bring in foreign currency to permit imports, and imports needed to make exports possible, have been hampered. Thus there is a scarcity of foreign currency which is responsible for an acute shortage of motor vehicles, parts, and tires needed on plantations which produce export crops. One West Java estate has attempted to solve the problem by going back to the use of horses!

In the case of tires, at least, the sharp decline in imports noted in Bruggeman's article, is apparently not made up by local production.

[1]June 16, 1955.

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Malaya

Seek Gold Coast Holdings

Certain Malayan companies are negotiating for the purchase of land in the Gold Coast suitable for growing rubber, it has been revealed by Lt. Col. J. H. Levy, chairman of Offin River Estates, a Gold Coast firm which owns concessions amounting to about 80 square miles.

The Gold Coast probably has about 15,000 acres suitable for planting rubber trees, Levy declared. Prospects that the Offin River company would transfer some of its land to the Malayan interests are reported to be good.

Rubber has been produced on the Gold Coast for the past 40 years, although in small quantities. Planters in Malaya have also been extending their holdings to Nigeria recently.

See Workers Wage Cut

The Malayan Planting Industries Employers' Association has asked its members to warn the 300,000 estate workers in the Federation to expect a 40% wage cut. Government law obliges the MPIEA to give a month's notice to workers before their wages are adjusted.

Association Secretary R. G. D. Houghton said that the present wage rate is based on the price of rubber being between $1.20 and $1.30 (Straits currency) and would have to be cut if rubber remains at the same price level or falls still further.

A wage cut would be the second reduction since October. Malayan workers are represented by the National Union of Plantation Workers, and most have their wages tied to the rubber price level. Contract tappers, checkroll tappers, and field workers are all expected to be affected. Contract tappers, for example, will probably have their daily wages cut from $3.75 to about $3.40, Mr. Houghton said.

Indonesian Smuggling Seen

Evidence has been reported that a large amount of rubber is being smuggled into Malaya from Indonesia. The evidence was obtained by a comparison of official statistics published in Malaya and in Indonesia and has been admitted as proof by the Indonesian Smallholders Rubber Department.

According to Malayan statistics, imports of smallholders' rubber from Indonesia totaled 23,848 tons for the first 10 months of 1955. Figures supplied by the Indonesian Smallholders Rubber Department, however, show exports to Malaya of 16,991 tons during the same period. The difference of about 7,000 tons is seen to be the amount smuggled into Malaya.

The Jakarta correspondent of the *Straits Times* writes that one of the known tricks of smugglers is to conceal the rubber between bales of lower quality rubber. The fact that the Malayan customs personnel are poorly equipped and under-staffed is said to have encouraged the smugglers.

It is believed that the smuggling has caused the rubber commodity on the Jakarta market to rise to a comparatively high price.

For Cess Fund Return

With concern mounting in Malaya over the slump in the price of natural rubber, the Federal Government has opened negotiations with the Rubber Producers' Council on the return of the anti-inflationary cess fund to the industry.

The flow of money into the fund ceased recently when the price of rubber fell below $1 a pound (Straits currency). Since last June the cess brought in about $55,000,000. Under the terms of a Government White Paper the fund is bound to return to the industry when the price of rubber falls.

Representatives of the Rubber Producers' Council are understood to be calling for the immediate return of the fund. They are negotiating with government financial experts led by Acting Minister for Economic Affairs Inche Khir Johari.

Industry representatives are believed to have told the government that the fund could be used to speed-up replanting. Meeting in Kuala Lumpur, spokesmen for both sides saw an agreement reached soon.

Urge No Stockpile Change

Malayan rubber executives have been urging the colonial government to press the United Kingdom for a reassuring statement that it will not tamper with the huge natural rubber stockpile there. The proddings resulted from the UK's recent announcement that it intended to reduce its commodity stockpiles as part of an overall anti-inflationary program.

Although no specific commodity was mentioned, it is felt that unless rubber is definitely excluded from the list, the selling price of this most-important Malayan product would continue to fall, to the detriment of the Malayan economy.

Many Malayan officials believe, however, that UK economists are only too aware of what the cutback in the rubber stockpile would mean to Malaya and would never take the step. This view is strengthened by the fact that UK officials themselves have urged the United States not to reduce its own rubber stockpile. Consequently the cutting of the United Kingdom stockpile would be too great a reversal of policy.

In the announcement of its anti-inflationary program, the United Kingdom said it would sell more of its stockpiles than it bought when turning over stocks.

Malayan planters say that the avowed object of the anti-inflationary program is to protect the sterling position, and to meddle with the natural rubber stockpiling procedure would result in the reduction of the gold dollar earning capacity of rubber.

The raising of the bank rate in the UK, combined with various anti-inflationary measures, has already caused much uneasiness in the Malayan rubber industry, it is said.

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Ceylon

Rubber/Rice Pact Prices

The Ceylon Trade Mission in Peking was finally able to arrange new prices for rubber supplied to China under the rubber/rice pact, substantially above the world market level. For 1955, the new rates reported were: 27d. per pound, if the monthly Singapore price average is under 22d. per pound; China will pay a premium of: 5d. per pound over the Singapore monthly average if it is between 22 and 35d. inclusive, per pound; 4d. per pound if the average is between 36 and 40d. per pound; and 3d. if the average is above 40d. per pound. The higher prices are retroactive to rubber supplied since June, 1955.

Price and quota for rice in 1955 remained unchanged. For 1956 the same rates as above apply, except in the price range of 29 to 25d., when the premium will be 4d. instead of 5d. per pound.

The higher rubber prices paid by China have led the Ceylon Government to increase its prices to producers on all grades of sheet by 15 Rupee cents per pound, as from October, 1955, bringing the new prices for #1 RSS. to R. 1.50 per pound; for No. 2, to R. 1.47; No. 3, to R. 1.44; No. 4, R. 1.20; and No. 5, to R. 1.15.

As a result of the better prices from China, Ceylon's replanting scheme is likely to be extended, and the Government of Ceylon is considering an increase in the replanting cess on rubber exports, double the present 9 rupee cents per pound.

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Ceylon Replanting

Ceylon has a five-year replanting program, initiated in 1953, with original target of 65,000 acres. Already 26,000 acres have been replanted, and permits for another 24,000 acres were issued this year, so that it is expected the present program will be

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completed ahead of schedule. Consequently it has been decided to extend the program and to replant between 25,000 and 35,000 acres in the next two years to bring the total to approximately 100,000 acres replanted.

The Rubber Rehabilitation Board, under which the program is carried out has asked for the release of Rs. 10,000,000 from the rubber price stabilization fund to help finance the additional undertakings.

The total area under rubber in Ceylon is about 657,000 acres, of which about 200,000 acres are considered uneconomic.

The government has decided to encourage the replanting with other crops on areas unsuitable for rubber, as cocoa in the areas at higher elevation, since this crop is better suited to the conditions at these altitudes than rubber. The substitution of citrus for rubber in the hilly areas of Uva is also being considered, it is learned.

Trade Pact with Poland

A Polish trade delegation arrived in Colombo recently to arrange a pact by which Ceylon would supply rubber and coconuts in exchange for agricultural machinery and glassware. Hitherto Poland imported only rubber from Ceylon (to a value of about 500,000 rupees) and in 1954 exported to Ceylon plate glass, cotton piece goods, and wire nails, valued at 270,000 rupees.

Tire Factory for Ceylon?

Reports are again afoot on the establishment in Colombo of a factory to produce automobile tires, by an American concern. Apparently the company has obtained government approval for an undertaking in which local capital will participate. Ceylon will restrict tire imports when the factory goes into production and in the early stages will grant relief from taxation.

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Indo-China

Rubber Production Efficiency Up

As a result of the wars in Indo-China, the acreage under rubber on estates of more than 500 hectares (hectare = 2.47 acres) in Viet Nam has decreased in the 10-year-period from March, 1945, to the end of April, 1955, according to an article in *Bulletin du Viet Nam* for July 15, 1955.[1] The total planted area on these estates in 1945 was 72,614 hectares, against 63,487 hectares in 1955, and the number of employes was 44,000, against 26,000.

Although a reduction occurred in acreage and number of workers, output increased from 41,220 tons in 1943 to 54,226 tons in 1953, thanks to modernized methods of exploitation and the work of the Rubber Research Institute of Indo-China and its experiment stations.

All but two enterprises with combined area of approximately 1,000 hectares are in southern Viet Nam, and most of the plantations are exploited by French and foreign concerns. At present only 8,038 hectares are worked by Viet Nam rubber growers, and this acreage is divided into 134 holdings, some of which do not cover more than one hectare. In recent months, however, Viet Nam companies have bought up several *Hevea* estates that were damaged during the upheavals.

Local consumption of rubber is low and is estimated at not more than 1,000 metric tons annually. Of this 50% goes into crepe soles; the rest is used by a few foreign concerns in the manufacture of tires and tubes, foam rubber mattresses, molded rubber, and footwear, and by a few Chinese and Viet Nam craftsmen who make toys. Now that Viet Nam has regained its economic independence, however, more rubber manufacturing enterprises are expected to be established here before long.

News from other sources indicate that French businessmen in Viet Nam are facing many of the same problems as their European colleagues in Indonesia. Here, too, there has lately been a very drastic cut in imports because of the difficulty of obtaining foreign exchange, and the rulings on the transfer of funds, even for essential purposes, seem more stringent than in Indonesia so that many firms have reportedly decided to slow down their activities, when they have not stopped them altogether. The extent of this movement by businessmen has evidently made the Viet Nam Government uneasy, for last reports indicate that it is ready to relax the regulations in question.

[1] Reprimed in *Rev. gén. caoutchouc*, Aug., 1955.

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France

New Latex Gelling Agents

The requirements of the ideal thermosensitizing agent for latex are that it should permit latex to be stored at room temperature without modification of its properties; it should make it possible with increased temperature, to obtain in a matter of minutes, a gel of regular structure conforming exactly to the shape of the mold, and that viscosity and mechanical stability should remain unchanged. Results of tests on certain sensitizers carried out by C. Pariente at the Institut Francais du Caoutchouc[1] appear to indicate that triacetine, nitromethane, and nitropropane largely answer these requirements.

Triacetine is very easily incorporated by simply pouring into the latex (the optimum dose is two grams for 166 grams of 60% latex), in presence of 3% ZnO (on the rubber content). Triacetine can heat-sensitize latex without ZnO, but the gel obtained is fragile and tears when removed from the mold. Addition of ZnO intensifies the sensitizing effect, and excellent gels are obtained with optimum triacetine, with tensile strength of 349 kg/cm² (4956 psi.) and tear resistance of 79 kg/cm (442 lbs./in.).

Latex mixtures containing nitromethane did not gel when kept 35 days at room temperature, but then appeared as a very thick paste. The tensile strength, with optimum dose of two grams of nitromethane, was 380 kg/cm² (5396 psi.), and tear strength 88 kg/cm (493 lbs./in.). Nitromethane has the disadvantage, however, of giving brown vulcanizates.

Latex mixes treated with nitropropane showed unusually good mechanical properties: tensile strength 405 kg/cm² (5751 psi.); and tear strength, 100 kg/cm (560 lbs./in.). It too is easily incorporated into the latex, and, moreover, it does not give brown vulcanizates.

Thermosensitizing action and aging were excellent for all these substances, and because of their other good properties, it is suggested that they may with advantage replace the classic heat sensitizers.

[1] *Rev. gén. caoutchouc*, 32, 2, 133 (1955).

Plan Synthetic Plant

A new synthetic rubber factory is scheduled for Le Havre by the French Socabu company, recently formed by leading petroleum, chemical, and tire companies. The plant, expected to start operating early in 1958, will be designed to produce 20,000 tons of butyl rubber annually. Esso Standard and Cie. Française de Raffinage will supply the necessary isobutylene, it is learned.

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Italy

Pirelli Lastex Moves

Pirelli Lastex, Societa Italo-Americana Filo Elastico, has announced that owing to the work connected with the projected erection of a Pirelli skyscraper, its offices can no longer be housed in the building at Via Pirelli No. 10, Milan, and have therefore temporarily been moved to Via Giulini 2, Milan.

Plans for the skyscraper have already been completed and provide for a 30-story main building, 124.40 meters high, 68 meters long, and 18 meters wide in the center, besides other buildings, on a site having an area of 7,200 square meters of which about half will go for traffic and parking space.

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Turkey

The Turkish Government is to embark on the local production of tires, Ankara Radio recently announced, adding that German experts were called in to advise on the setting up of a tire factory.

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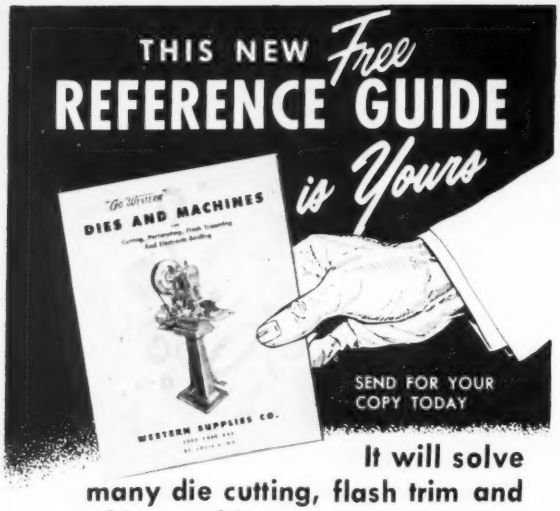

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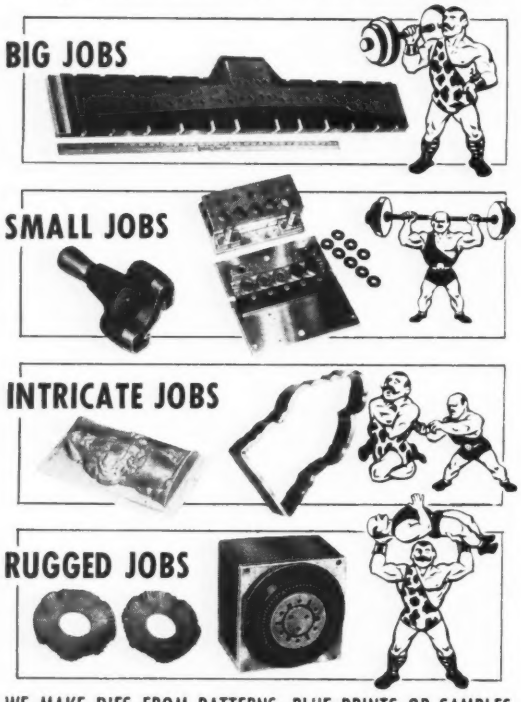

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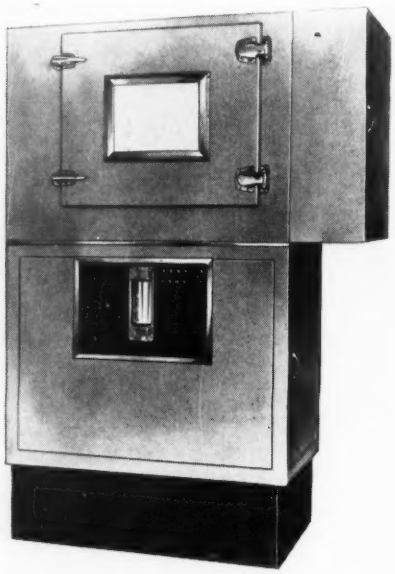


Mast Development's Model 700-1 ozone chamber

Ozone Test Chamber for Rubber

A new laboratory chamber for testing the ozone resistance of rubber and other organic materials in accordance with current SAE-ASTM standards has been placed on the market by Mast Development Co., Inc., Davenport, Iowa. Designated Model 700-1, the chamber is said to be capable of maintaining ozone concentrations up to 750 parts per hundred million. Freshly ozonized air may be introduced at flow rates up to eight cubic feet per minute, and air circulation over the samples can be maintained at a rate of two feet per second. Temperature control is afforded over a range from 5° below ambient to 150° F.

The unit is 76 inches high, 54 inches wide, and 28 inches deep. The interior chamber is of stainless steel, and the exterior is grey Hammerloid enamel trimmed with chrome.

Top Entering Agitator

A line of top entering mixers, either of the turbine or paddle type, is being offered by Cleveland Mixer Co., Cleveland, O. Called the K-Series, the line has such features as easily adjusted variable speeds, standard gear construction for simple maintenance and interchangeable gear ratios, an agitator load independent of the gear reducer, a shaft operating in two anti-friction bearings, and the absence of runout at the stuffing box or seal. The housing is constructed of steel. The K-Series is available in six sizes in a wide range of horsepower and output speed.

Data sheets giving specifications of the mixers can be obtained from the company.

Speed King Valve Speed Controller

An attachment for its Speed King valves that is said to effect precise variation and control of cylinder operating speeds has been announced by Valvair Corp., Akron, O. Designed for use on

NEW

PLASTOLEIN® 9404 TGP

a superior

synthetic rubber plasticizer

at lower cost!

New Plastolein 9404 TGP (triethylene glycol dipelargonate) offers superior performance in synthetic rubbers. Yet it *costs less* than commonly used low-temperature plasticizers.

For example, as compared to other more expensive glycol-type esters and adipate plasticizers, 9404 gives lower heat loss, lower compression set, less water sensitivity and equivalent low-temperature flexibility.

In addition, since Plastolein 9404 is produced in accurately controlled equipment from easily obtainable domestic raw materials, high quality standards are maintained and continuing availability assured.

For detailed information on Plastolein 9404 TGP, mail coupon, or write for an evaluation sample.

Emery

Fatty Acids & Derivatives
Plastolein Plasticizers
Twitchell Oils, Emulsifiers

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio

New York • Philadelphia • Lowell, Mass. • Chicago • San Francisco • Cleveland
Warehouse stocks also in St. Louis, Buffalo, Baltimore and Los Angeles
Export: Carew Tower, Cincinnati 2, Ohio

Emery Industries, Inc.
Dept. B-4, Carew Tower, Cincinnati 2, Ohio

Please send me bulletin on Plastolein 9404 TGP.

Name.....*Title*.....

Company.....

Address.....

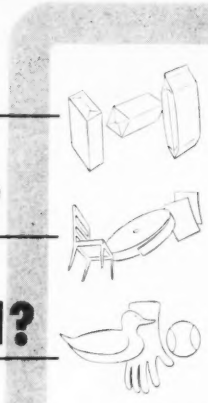
City.....*State*.....

LIKE TO CUT THE UNIT COST OF YOUR PRODUCT?

IS IT **coated?**

IS IT **heat sealed?**

IS IT **slush molded?**



THEN YOU SHOULD TALK WITH AN ARCCO ENGINEER

Unless you have talked with an ARCCO Engineer recently, you aren't up to date on the newest, most satisfactory and most economical

EMULSIONS
SOLUTIONS
HOT MELTS
PLASTISOLS

ARCCO offers you a complete compounding service. Standard ARCCO formulations cover a wide range of uses. Or, ARCCO will develop and compound modifications or special formulas tailored to your specific requirements. It will pay you to consult an ARCCO Engineer.

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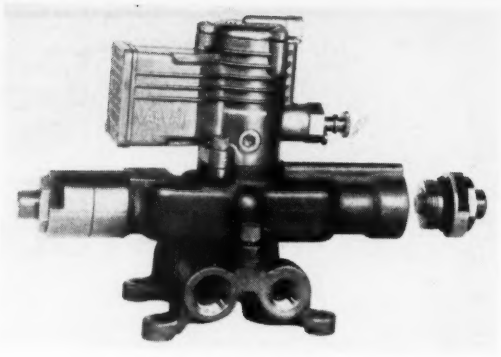
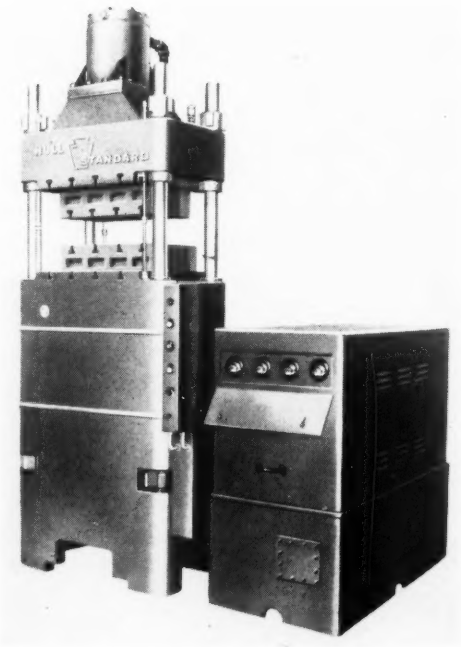


Valvair speed control attachment

three-way and four-way Speed Kings with internal and external pilot supply, the speed-control attachment mounts in the valve end caps. The device functions by restricting stem travel, thus regulating flow through the valve to and from the cylinder. Threaded stop screws at either end of the valve body may be adjusted to position the valve stem through a complete range of flow control, from fully restricted to fully open, in both directions, according to the company.



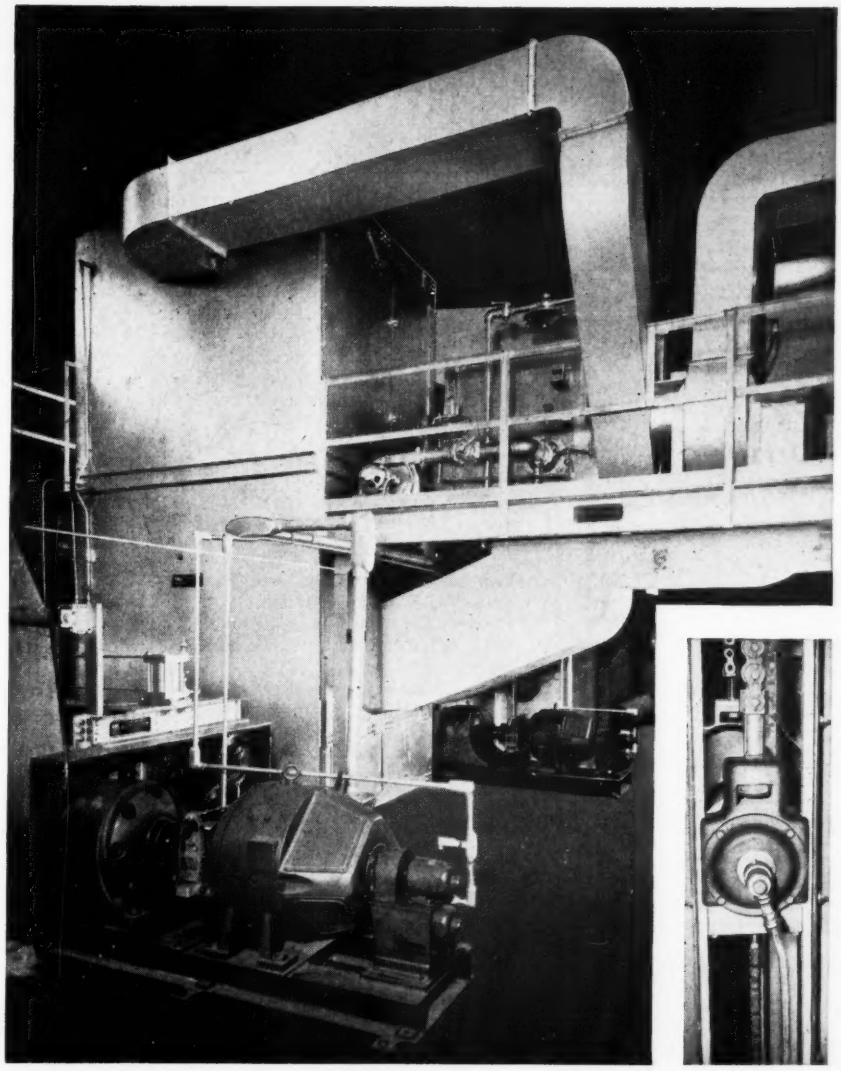
Hull-Standard Model 250-C Press

Fast Molding Alkyds Press

A toggle-type, hydraulically 150-ton actuated molding press with a minimum opening and closing time of two seconds has been introduced by Hull-Standard Corp., Abington, Pa. This high-speed action, obtained with differential cylinders which operate four times as fast as in previous models and with the same low power requirements, according to the company, is said to be particularly suited to alkyds, as well as to other plastics.

Other features of the new press are said to include operating dials; a spray lubricated, totally enclosed toggle mechanism; differential cylinders for both compression and plunger molding; top and bottom ejection; a main cylinder valve—cushioned at both ends of stroke; and a totally enclosed and self-contained power unit with water-cooled oil reservoir.

The Hull-Standard press is available in Compression Model 250-C, Transfer Model 258-C, and Combination Model 259-C.



Within the first day of startup, full width nylon tire cord processed in this 30-yard-per-minute, 14,000-pound-tension **IOI** Rollevator® Oven*, was made into aircraft tires meeting all qualification tests.

The Rollevator® roll automatically moves up and down within the oven, in direct relation to line speeds. Thus, at *any line speed, heat-exposure* time of the nylon is held *constant* at a constant temperature setting and at constant tension.

Rollevator® Oven* hot stretches nylon tire cord at constant optimum temperature, constant time and constant tension, at variable line speeds

The IOI Rollevator® Oven* is the answer to more uniform hot stretching of nylon with greater production efficiency. Simple and automatic in operation, it practically eliminates costly shutdown and repair time. When the line is stopped the Rollevator® roll automatically lowers out of the heat zone, eliminating the need for quick cool purging of the oven and the time and expense involved in reheating the oven when starting up again. Its low operating cost combined with low initial cost assures you of lower production cost. An IOI sales engineer will be glad to give you complete information about the Rollevator® Oven* and to discuss your requirements for any system from 3 to 100 yards per minute.

®Trade Mark Registered
*Pat. Applied For

INDUSTRIAL IOI ENGINEERING VERSATILITY **OVENS, INC.**

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POLYISOBUTYLENE DISPERSION 108

a stable, aqueous dispersion of VISTANEX*. The product is unloaded and yields a colorless, tacky film when the moisture is removed. VISTANEX is widely known for its stability, resistance to aging and chemical inertness. The VISTANEX dispersion is compatible with natural and synthetic latex.

*Trade Mark, Enjay Company, Inc.

SUGGESTED USES

1. Pressure sensitive adhesives
2. Tackifier and binder
3. Protective coatings
4. Sealing compounds
5. Additive for latex compounding
6. Modifier for dextrine, gums and starches
7. Textile coatings
8. Textile laminating
9. Adhesives for flock printing
10. Binder for cellulose, textile and leather fibers.

SPECIFICATIONS and PROPERTIES

Appearance
Milky white liquid

Solids
55% ± 1.5%

pH
10-11

Specific Gravity
0.97 approximately

Coagulum
0.5 max. retained in 60 mesh

Viscosity
Medium

For complete technical data and sample, send to

M-S MILLER-STEPHENSON CHEMICAL CO., INC.
550 Fifth Avenue, New York 36, N. Y.

FOAM LATEX COMPRESSION TESTER

Meets A.S.T.M. Specification
100 lb. 1/10 Toledo Scale Range
Table 36" x 72"—up to 6" thick stock
For Production and Laboratory Tests.

Exclusive Manufacturers

FERRY MACHINE CO., KENT, OHIO

Export Sales Through Binney & Smith, International

NEW MATERIALS

Emersol 213 Low Titer Elaine

A new single-distilled oleic acid has been added to the fatty acid line of Emery Industries, Inc., Cincinnati, O. Called Emersol 213 Low Titer Elaine, it is said to be identical to the company's standard Emersol 211, except for being lighter in color. The formal color designation for Emersol 213 is 1-2 Red (1" Lovibond). That of Emersol 211 is 3-6 Red (1" Lovibond).

Piccopale A-1 Emulsion for Latex Paints

A resinous modifier that is said to reduce the cost of latex paints while improving their quality has been placed on the market by Pennsylvania Industrial Chemical Corp., Clairton, Pa. Designated Piccopale A-1 Emulsion, it is claimed to effect easy soil removal at high pigment volumes; to have high resistance to soap, water, and alkalies; to permit permanent film flexibility; and to improve initial adherence. Other of the modifier's characteristics, according to the company, are its excellent pigment binding, compatibility with thickeners and protective colloids, and its package and mechanical stability. The emulsion is said to have an average particle size of less than 1.0 micron.

A one-page bulletin describing the emulsion and its applications is available from the company.

G-E Silicone Emulsion SM-62

A 35% base emulsion of methyl silicone fluid in water, said to be ideally suited to mold release applications where maximum stability, release performance, and excellence of finish are desired, has been introduced by General Electric Co., silicone products department, Waterford, N. Y. Named SM-62, the silicone emulsion has fine and uniformly distributed silicone particles and is very stable when heated and after dilution with hard or soft water, according to the company. This emulsion is white in color and weighs 8.2 pounds a gallon.

General Electric recommends it as a mold release agent for the manufacture of tires, mechanical rubber goods, rubber and vinyl flooring, and plastic products.

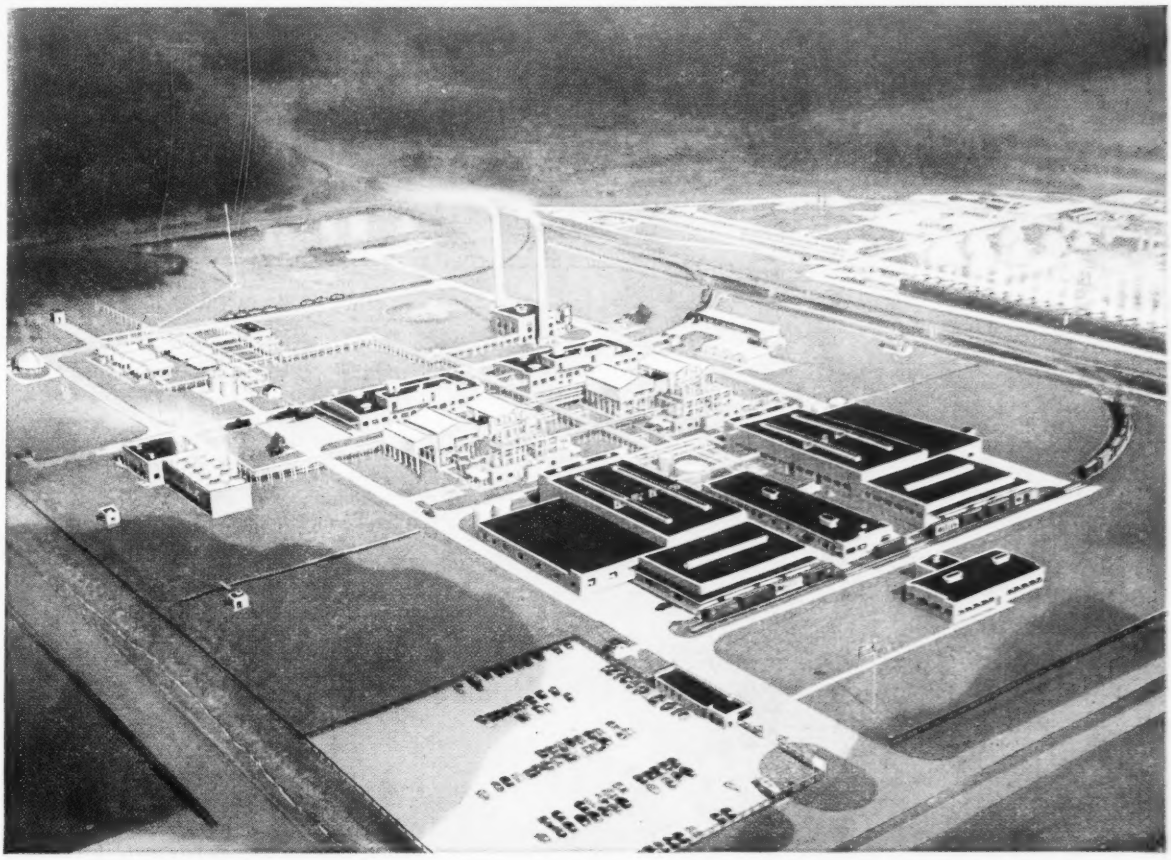
The material is described in a technical bulletin, "SM-62," available from the company. Also available is bulletin AD 9-A, "Use of G-E Silicone Mold Release Agents in Rubber Manufacturing."

Stabelan 120 Non-Staining Stabilizer

A liquid, non-staining stabilizer in hydrogen sulfide atmosphere for polyvinyl chloride resins and copolymers has been added to the stabilizer line of Harwick Standard Chemical Co., Akron, O. Called Stabelan 120 and manufactured by Stabelan Chemical Co., the new material is said to give films and sheetings of a high degree of clarity and is recommended for calender, solution, and dispersion-type polyvinyl chloride resins.

The stabilizer is compounded of zinc and barium organic salts with a chelating agent. It is compatible with all currently used vinyl chloride polymers and copolymers, primary and secondary plasticizers, as well as organic and inorganic pigments, according to Harwick Standard. The material has a specific gravity of 1.01, an ash content of 13.0%, and is insoluble in water, but soluble in naphthas, cyclic hydrocarbons, ketones, a d plasticizers.

Bulletin #15-29-1-2-56, describing the material and reporting some test data, is available from the company.

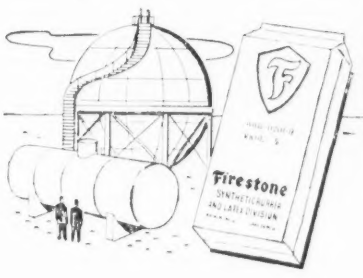


Firestone, world's largest rubber producer, expands its synthetic rubber program

Today rubber consumption is at an all-time high and Firestone is straining every facility to make more high quality rubber and latex to meet the tremendous demand. The synthetic rubber plants, at Lake Charles and Akron, are working 'round the clock and Firestone is planning ahead . . . a multi-million dollar expansion program will soon increase the production capacity of Firestone synthetic by nearly 50%.

Synthetic rubber is not new to Firestone . . . even before Pearl Harbor, while the entire rubber industry was frantically working on a substitute for natural rubber, Firestone scientists had actually produced the same synthetic rubber which eventually became GRS. Then in April 1942, Firestone began operation of the first government synthetic plant. Since that time, these same research scientists have been constantly striving to make a better rubber. The latest achievement of Firestone scientists is a chemical duplication of natural rubber, the life-long goal of research chemists.

Look to Firestone for all your rubber needs. With over 30 years' experience gained from the operation of its vast Liberian Plantation and its aggressive research in synthetic rubber, Firestone is better equipped to meet your problems. A Firestone Technical Representative will be glad to work with you. Phone or write Firestone, Synthetic Rubber and Latex Division, Akron, Ohio.



Firestone

BEST IN RUBBER

COMPOUNDING MADE EASIER WITH NEW PLASKON† POLYETHYLENE LUBRICANTS

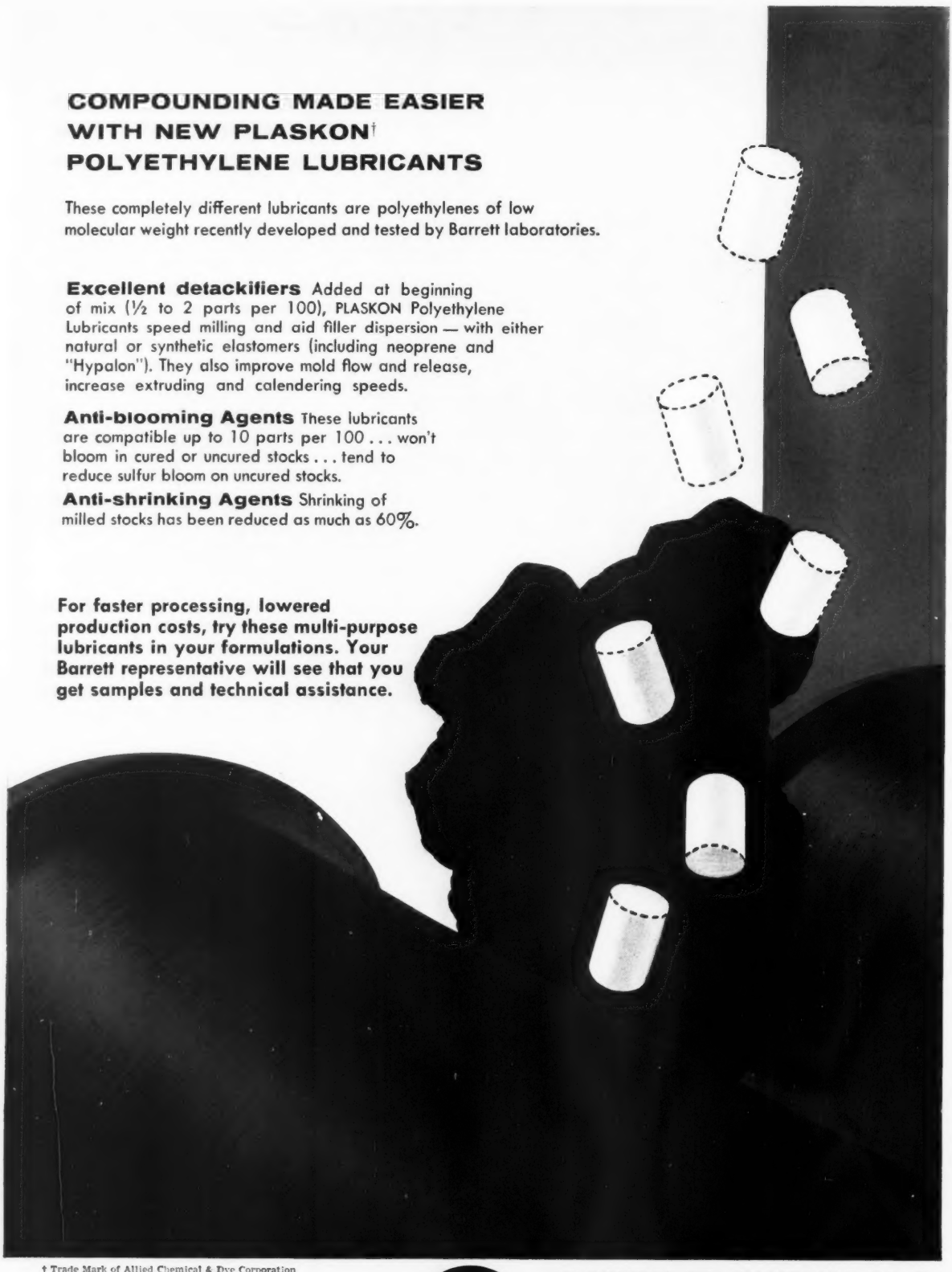
These completely different lubricants are polyethylenes of low molecular weight recently developed and tested by Barrett laboratories.

Excellent detackifiers Added at beginning of mix (½ to 2 parts per 100), PLASKON Polyethylene Lubricants speed milling and aid filler dispersion — with either natural or synthetic elastomers (including neoprene and "Hypalon"). They also improve mold flow and release, increase extruding and calendering speeds.

Anti-blooming Agents These lubricants are compatible up to 10 parts per 100 . . . won't bloom in cured or uncured stocks . . . tend to reduce sulfur bloom on uncured stocks.

Anti-shrinking Agents Shrinking of milled stocks has been reduced as much as 60%.

For faster processing, lowered production costs, try these multi-purpose lubricants in your formulations. Your Barrett representative will see that you get samples and technical assistance.



† Trade Mark of Allied Chemical & Dye Corporation

CHEMICAL PROGRESS WEEK-APRIL 23-28

Barrett®

BARRETT CHEMICALS

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OVER 100 YEARS OF EXPERIENCE

Allied Chemical

FT-200 and FT-300 Hard Mineral Waxes

Two extra-hard mineral waxes for use as detackifying, mold-release, and lubricating agents in rubber compounding are being marketed by Dura Commodities Corp., New York, N. Y. Designated FT-200 and FT-300, they are aliphatic hydrocarbons of high-molecular weight and are being manufactured by the German firm, Krupp Kohlechemie. Other valuable properties of the waxes, according to Dura, are high melting-point, solidification point, and dropping point, superior electrical properties, and gloss production.

Some typical reported properties of the two waxes follow:

	FT-200	FT-300
Melting point (capillary tube)	212° F.	221° F.
Solidification point (rotating thermom.)	198/203° F.	208/216° F.
Dropping point (Ubbelohde)	223/226° F.	230/234° F.
Penetration (100 g., 5 sec., 77° F.)	3-5	below 1.0
Iodine number	3-5	3-5
Density @ 68° F	0.925	0.933
Flash point (open cup)	424° F.	536° F.
Viscosity @ 266° F	7.4 cSt	10.7 cSt
Color	white	white

Nevastain A, Non-Staining Antioxidant

A non-staining, non-discoloring antioxidant for natural and synthetic rubber compounding, said to exhibit very low volatility and good stability, has been introduced commercially by Neville Chemical Co., Pittsburgh, Pa. Designated Nevastain A, the liquid material is insoluble in water and soluble in a wide range of organic solvents, according to the company.

Some physical properties of Nevastain A reported by the company include the following: color, Gardner, 9 maximum; specific gravity @ 30° C., 1.08 to 1.09; flash point, C.O.C., °F., 275 minimum; and viscosity, S.S.U. @ 210° F., 50 to 60.

Data sheets on the new material, technical service report No. 45, giving a typical natural rubber recipe using the antioxidant with accompanying post-cure test data, are available from Neville.

UC Silicone Rubbers K-1025 and K-1028

Two new silicone rubber compounds for rapid one-step thick-section curing have been placed on the market by the silicones division of Union Carbide & Carbon Corp., New York, N. Y. Designated K-1025 and K-1028, the rubbers have low compression set, valuable in making such goods as refrigerator door seals, kitchen oven door gaskets, and heat- and cold-proof motor mounts, and are said to meet or exceed Aeronautical Materials Specifications and specifications of the American Society for Testing Materials. The rubbers are available in neutral or red color.

K-1025 has a 50 durometer hardness; while K-1028 has a hardness of 80. Compounds with intermediate hardnesses of 60 and 70 can be prepared by the fabricator by blending different quantities of the two rubbers, according to the company, or may be ordered under the designations K-1026 and K-1027.

Data sheets containing recommended curing procedures and test data on K-1025 and K-1028 may be obtained from Union Carbide.

UOP Antiozidant 288

A companion product to its Antiozidant 88[1] has been put on the market by Universal Oil Products Co., Des Plaines, Ill. Called Antiozidant 288, the material is said to be an isomer of Antiozidant 88, also giving superior antiozidant protection in natural and synthetic rubber stocks. It is heat-stable, making it advantageous in such goods as automobile tires, according to the company. The amount recommended for Banbury inclusion is 2-4% by weight on the rubber in the compound. The antiozidant is reported to accelerate curing sometimes, reducing quantities of sulfur or accelerator needed.

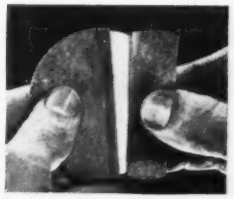
[1] RUBBER WORLD, Apr., 1955, p. 104.

Patapar

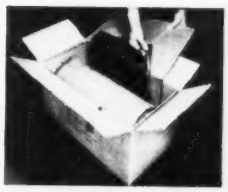
RELEASING PARCHMENTS

peel off easily from pressure sensitive and tacky surfaces

Separator for rubber tape — just the right "release" action



Ideal backing for pressure sensitive surfaces



Effective separator sheet for uncured, natural or synthetic rubbers

Releases readily from pressure sensitive plastics

Correct "releasing" action in almost any situation is provided by new *low cost* Patapar Releasing Parchments. These special types of Patapar Vegetable Parchment excel as a backing material, liner, interleaver, overwrap, separator sheet and many other uses.

Features of Patapar Releasing Parchments include: *dense, fibre free texture; high resistance to penetration or migration of oil and softeners; permanent releasing action.*

Tell us your intended application and we will gladly send testing samples and technical data.

Write today

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West Coast Plant: Sunnyvale, California

Patapar Vegetable Parchment
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for every purpose, wherever
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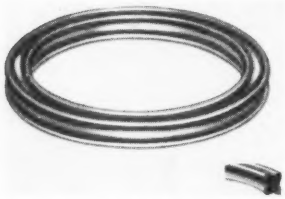
Akron, Boston, Chicago, Los Angeles, Trenton,
Albertville, (Ala.), Denver

NEW PRODUCTS

BFG Hot Materials-Handling Conveyor Belt

A synthetic rubber hot materials-handling conveyor belt has been placed on the market by The B. F. Goodrich Co. Industrial Products Division, Akron, O. Known as Solarflex, the belt is said to remain pliable after long exposure to materials at temperatures as high at 350° F., because of the special synthetic rubber compound used. A longevity three times greater than that of conventional hot materials belts is claimed for the new product. The belt is available in widths up to 72 inches and in lengths up to 1,000 feet. It is produced with glass, rayon-nylon, rayon, cotton-nylon, or cotton fabric reinforcement.

Four-Lipped Rubber Hydraulic Seal



Minnesota Rubber & Gasket's Quad Ring

A four-lipped rubber hydraulic seal for hot or cold applications that is said to create a more effective seal than an O-ring while producing less friction, thus lengthening the life-span of the product, has been developed by Minnesota Rubber & Gasket Co., Minneapolis, Minn. Dubbed Quad Ring, it eliminates torque leakage at low-pressure differentials and spiral twist failures or rolling with pulsating pressures, according to the company. Ability to perform efficiently without extra-fine groove finishes and close metal tolerances is also claimed for the ring. A range of sizes is available.

New Ice Slinger Hose

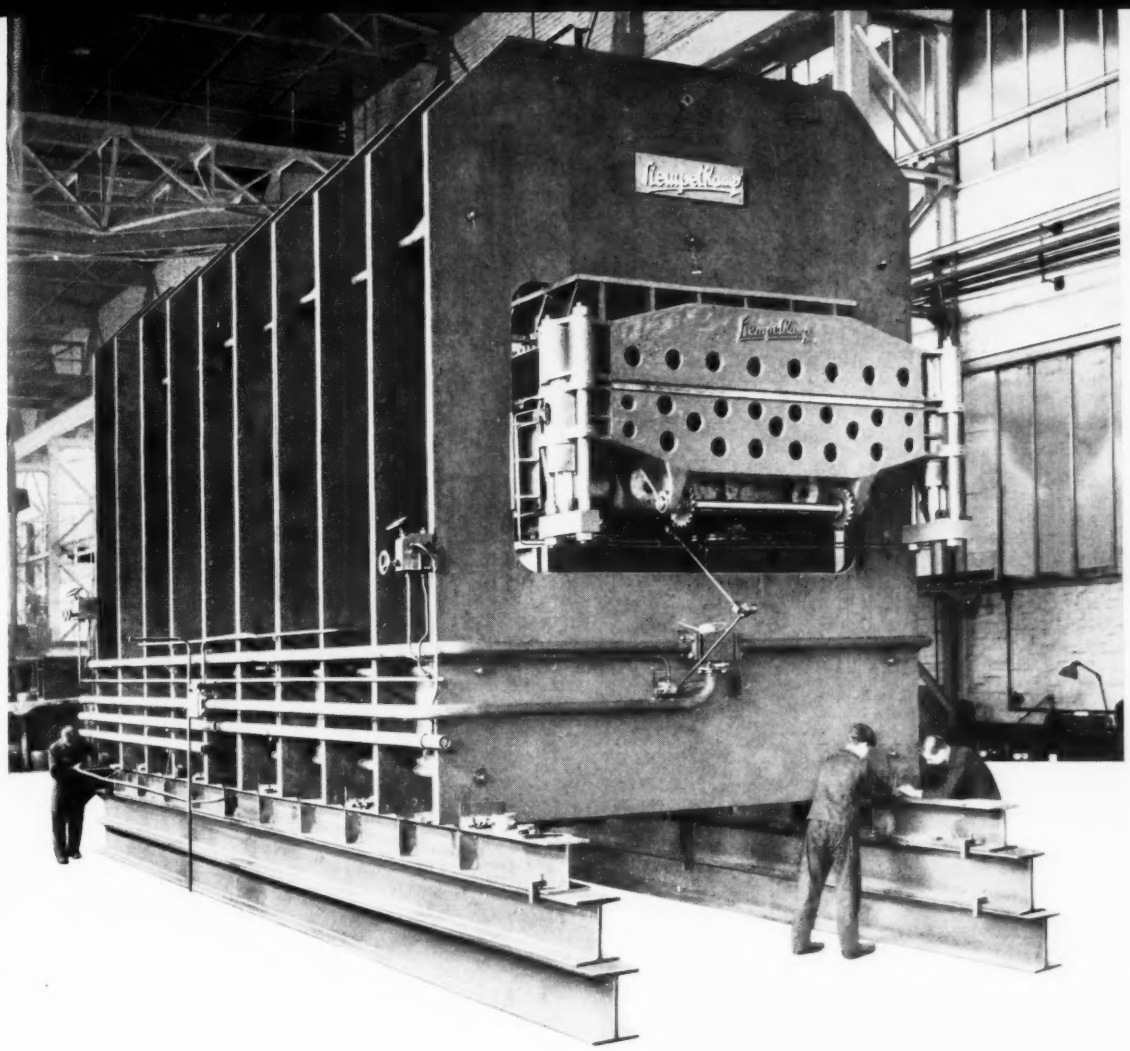
A lighter, more flexible version of its Ice Slinger hose for blowing crushed ice into transporting vehicles has been introduced by The Goodyear Tire & Rubber Co., Akron, O. Coded 25W336, the hose is a wire-inserted, abrasion-resistant rubber tube with a fluted cover. Inside diameters of the hose range from three to five inches and lengths from three to 50 feet.

Goodyear Open-Hearth Furnace Hose

Also from Goodyear comes a new open-hearth furnace-door hot water and steam hose for steel mills, which is said to be made of a special rubber compound reinforced with steel wire braid and insulated with asbestos. This hose is covered with an open braid of stainless steel wire which increases the flexibility of the hose and minimizes build-up of molten spatter, the company says. The hose is made with inside diameter sizes of one inch and 1¼ and 1½ inches and is furnished in lengths of 45-50 feet, unless otherwise specified.

Sponge Rubber Carpet Underlay

Carpet underlay made of sponge rubber with a fiber backing has been placed on the market by United States Rubber Co., New York, N. Y. Called U. S. Rug Underlay Airbase, it is available in a width of 53 inches and will be sold in 30-square-yard or 20-lineal-yard rolls. The underlay is said to have great tensile strength, to be easy to lay, and not to provide a habitat for insects.



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Hydraulic Rubber Belt Presses

Dimensions up to 128" wide by 600" long

The leading rubber factories in Europe use Siempelkamp Belt Presses

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WHITTAKER CLARK & DANIELS, INC.

260 West Broadway
New York 13, N. Y.

Firestone President Lee R. Jackson exhibiting Supreme tubeless tire

Firestone Supreme Tubeless Tire

A new nylon cord, puncture resistant, blowout-safe tubeless tire designed as the "safest and longest-wearing passenger car tire ever offered to American motorists" has been introduced by the Firestone Tire & Rubber Co., Akron, O. The tire is completely new in appearance and is said to be the first one ever styled with the help of a large number of motorists through a public poll.

The new Firestone Supreme tubeless tire has a specially compounded gummy sealant that prevents air leakage from penetrating nails and other similar objects. Blowout protection is assured by a specially contoured safety diaphragm made of two plies of rubberized nylon cord and an ingenious safety valve that automatically locks two-thirds of the air into the tire's inner air chamber when the outer casing is ripped open or slashed.

The tire has an exclusive tread design based on new engineering principles which virtually eliminates tire squeal and which provides a great increase in traction from thousands of integral skid resistors. Running in a diagonal direction, these skid resistors improve forward traction and guard against side skidding.

Other construction features include a special synthetic rubber interliner and a new cold rubber compounded with specially developed furnace carbon blacks for increased tread mileage. The white sidewall also contains new compounds that will prevent discoloration and protect it from ozone cracking, it is said.

Parker Fuel Oil O-Ring Seals

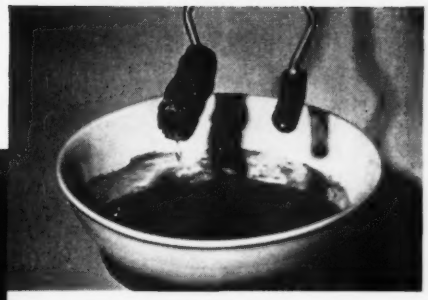
Synthetic rubber O-ring seals for fuel-oil service have been placed on the market by Parker Appliance Co., rubber products division, Cleveland, O. The seals have Underwriters Laboratory approval for use with fuel oils and are said to have undergone exacting tests with six different fuel oils.

Designation for the synthetic rubber compound from which the seals are made is Parker Compound 37-751.

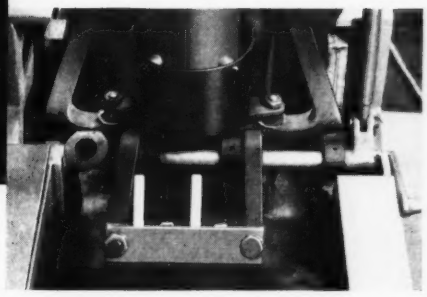
Smaller Home-Trailer Tire

A small-size home trailer tire that "eliminates bulky wheel housings and lowers the trailer's center of gravity, providing a smoother, safer ride," has been placed on the market by The Dayton Rubber Co., Dayton, O. Designated Low Boy, the tire has a 10-inch inside diameter, which is said to be five inches less than for standard types.

SILASTIC GUMS
give you 4 outstanding properties

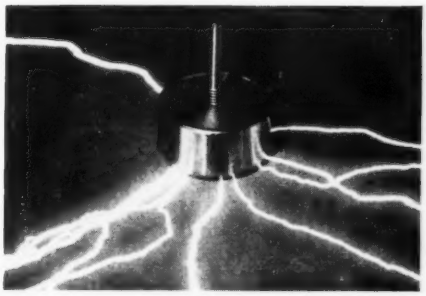


Stability at 500 F.



Elasticity at—100 F.

Minimum compression set over a span of 600 degrees



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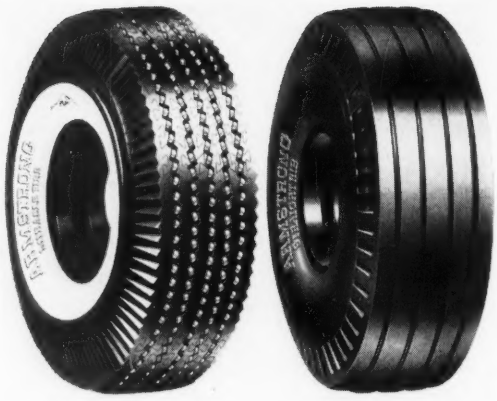


Armstrong 14-inch Miracle tread tire

Armstrong Straight Rib Tire

Front-Wheel Truck Tire

A front-wheel truck tire with a straight-rib tread design said to make for easier steering, greater maneuverability, and longer tire life comes from Armstrong Rubber Co., West Haven, Conn. Called Armstrong Straight Rib Tire, it has deeper mileage skid depth than have other types on the market, "labyrinth"-type grooves to prevent the embedding of stones, and a shock- and bruise-resistant carcass, according to the company.

Armstrong 14-Inch Passenger Tire

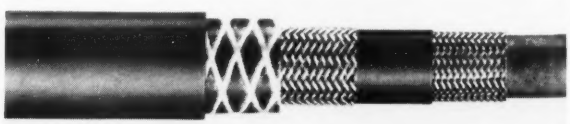
A full line of passenger tires in the 14-inch size also has been placed on the market by Armstrong. Available in the company's Premium, Miracle, and Silent Storm King tread designs, the fatter tires will reduce car heights, the company says, and their lower pressures will provide more comfortable rides. The width of the new tire is about ½ inch greater than that of conventional tires and thus permits a drop in the air pressure from 24 to 20 psi.

Colored Slip-on Sidewalls

Pink, red, blue, green, yellow, and white slip-on sidewalls for tubeless or tubed tires are being marketed by The Firestone Tire & Rubber Co., Akron, O. Made of a natural and synthetic rubber blend, the sidewalls are said to be easily installed and to stay secure at any speed. They fit between tire bead and wheel rim.

Glass-, Steel-Reinforced Rubber Hose

A synthetic rubber hose reinforced with steel wire and glass fiber has been developed by Hewitt-Robins, Inc., Stamford, Conn., for the handling of hot oil used in the construction of asphalt and other tarvia-type roads. Called Hewitt-Robins hot asphalt hose, it is said to be flexible and relatively light in weight and can withstand the effects of high temperatures, chemically caused decomposition, and rough handling, according to the company. The hose has a maximum working pressure of 250 psi. It is available with inside diameters of ¾-inch, one, 1½, and two inches.



Hewitt-Robins hot asphalt hose

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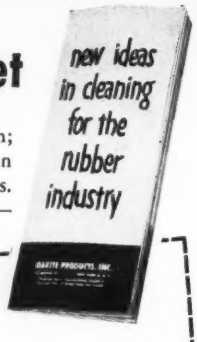

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TECHNICAL BOOKS

BOOK REVIEWS

"Chemical Pilot Plant Practice." Donald G. Jordan. Interscience Publishers, Inc., New York, N. Y. Cloth cover, 5½ by 8½ inches, 152 pages. Price, $3.50.

A pilot plant, the author says, has three objectives in view: obtaining experimental data, producing the required amount of product, and examining the by-products. He adds that only infrequently do they actually produce engineering design data, but instead they serve as a proving ground for theories and results from the laboratory. Intentionally a small book, the author not attempting complete coverage, the volume is divided into such topic divisions as general considerations, the scale-up problem, the handling of solids, liquids, and gases, chemical reactors, the separation process, and cost estimation and report writing.

"Encyclopedie Technologique de L'Industrie du Caoutchouc." Volume IV. Edited by G. Genin and B. Morisson. S. R. L. Dunod, Paris, France. Cloth cover, 6½ by 10 inches, 588 pages. Price, 5,400 francs (about $16).

The fourth edition of this French technical encyclopedia on the rubber industry concerns itself with two subjects: tires and uses of latex. Under tires, such topics as the history, fabrication, techniques of testing, reinforcement, and repairing of tires are dealt with. Under latex, both natural and synthetic, chapters treating compounding ingredients, molding, sponge production, latex adhesion, latex paints, electric wires and cables, analyses, and testing are included, among others.

The articles were written mostly by French specialists in the field, based primarily on the operation and achievements of the French rubber industry. The intent of the work was to cover both the industrial and theoretical points of view. The volume is illustrated with photographs, graphs, and data tables.

NEW PUBLICATIONS

Publications of Enjay Co., Inc., New York, N. Y.:

"Factors Affecting the Ozone Resistance of Enjay Butyl Vulcanizates." Enjay Butyl Bulletin No. 1. 6 pages. How to get the optimum ozone resistance from Enjay Butyl stocks through control of the state of cure, carbon black type and loading, cure system, sulfur content, and contamination with other polymers, and the proper selection of the polymer grade and plasticizers are described in this publication. Sample recipes and graphic comparisons of test data are also given.

"Enjay Butyl Sponge." Enjay Butyl Bulletin No. 1. 2 pages. Sample recipes for compounding black and colored sponge with Enjay Butyl rubber are reported here, together with compounding suggestions.

"Kel-F Elastomer." M. W. Kellogg Co., chemical manufacturing division, Jersey City, N. J. 12 pages. The properties, applications, compounding, vulcanization, and fabrication of the firm's fluorocarbon heat- and corrosion-resistant rubber are reported in this illustrated brochure. Sample recipes and post-cure test data are given for such applications as hose, tubing, diaphragms, gaskets, seals, tank linings, clothing, paints, sealants, and electrical insulation.

"Stan-Tone R. P. Vinyl Inks." Bulletin #02-69-1-1-56. Harwick Standard Chemical Co., Akron, O. 1 page. Properties and applications of these inks are given on this data sheet.

NEW Bulletin Tells Why Cab-o-sil® is an Excellent Flow Control Agent for Butyl Rubber Compounds

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Minimizes die swell
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Gives faster and better dispersion of color pigments
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Gives high tensile
Gives good stiffening effect
Contributes superior electrical properties

See for yourself how

- 5-7 P.H.R. Cab-o-sil in butyl rubber wire and cable compounds eliminate cold flow, reduce nerve of "green" stock, improve the extrusion rate, minimize die swell, have a definite thixotropic effect, and aid the dispersion of hard clays commonly used in such compounds.
- At low loadings, Cab-o-sil improves color development in weatherstripping and other colored butyl compounds, thereby reducing expensive pigment requirements and also improving extrusion and minimizing cold flow before curing.
- Cab-o-sil lends itself to the new "hot milling" technique by reducing the risk of depolymerization in a properly compounded stock. 12-15 P.H.R. Cab-o-sil give the aforementioned desirable results in wire and cable compounds plus greatly increased tensile strength, good stiffening effect and superior electrical properties. Low loadings of Cab-o-sil also control flow and give good thixotropy and thickening to rubber solutions, neoprene and other rubber-based adhesives.

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Surface Area (Nitrogen Adsorption)	*175-200 m.²/gm.*
Specific Gravity	*2.1*
Color	*White*
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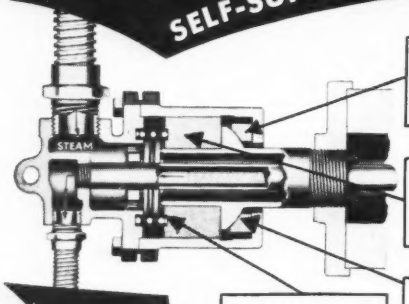

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Publications of Monsanto Chemical Co., St. Louis, Mo.:

"Vyram Solvent Resistant Elastomer." Technical Bulletin ODB-55-21. 30 pages. Compounding formulations, curative systems, and extensive test data on Vyram, a new solvent-resistant acrylate elastomer now being developed by Monsanto, are presented in this booklet.

"Styrene Monomer Storage and Handling." Technical Service Bulletin No. RM-10. Monsanto Chemical Co., plastics division, Springfield, Mass. 6 pages. Safe handling and storage of styrene monomer are discussed on these data sheets, together with the physical properties of the material.

"HB-40." Technical Bulletin O-104. The properties and applications of the company's HB-40, a secondary plasticizer compatible with a wide range of resins, appear in this bulletin. Applications of HB-40 include its use in the manufacture of plastisols for slush moldings and coatings, in vinyl tile, and in filled extrusions, such as those for SPT wire.

Publications of E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del.:

"Anti-Static Rug Backing." J. C. Fitch. Report BL-307. 7 pages. A recipe for making anti-static backing for nylon carpeting from cationic Neoprene Latex Type 950 and acetylene carbon black is included in this technical data report, together with compounding suggestions.

"Effect of Solvents on Neoprene, Polysulfide Rubber, Nitrile Rubber Elastomers and Their Blends." D. R. Kuespert. Report BL-308. 8 pages. The volume increase of these rubber stocks and their blends after a seven-day immersion in a variety of organic solvents is compared graphically in this publication.

"Hewitt-Robins News of Industry." March, 1956. Hewitt-Robins, Inc., Stamford, Conn. 16 pages. This is the first in a quarterly series of publications devoted to case histories of the company's rubber and machinery products in industry. Included in this issue are applications of the firm's acid-resistant hose in chemical manufacture and the use of its conveyors in a gypsum mine.

"Amendment II to RMA Type Descriptions and Packing Specifications for Natural Rubber." The Rubber Manufacturers Association, Inc., New York, N. Y. 1 page. This amendment, adopted by the RMA and endorsed by the RTA of New York, provides a third alternative method of packing Flat Bark Crepe that will permit the use of #1, 2, 3, or 4 Thin Brown Crepes as wrapper sheets for Flat Bark bales.

"Technical Digests." U. S. Edition, No. 1. Organization for European Economic Cooperation Mission Publications Office, Washington, D. C. 140 pages. $2.50 per issue; $24 a year. This is a collection of translated excerpts from European technical and industrial journals, published monthly by the European Productivity Agency, Paris, France, but available here. A great range of industrial fields is covered in this first issue, including chemicals, protective coatings and finishing processes, electrical engineering and equipment, power and lubricants, materials handling, packaging, safety, textiles, and transportation. Such newly developed equipment as a shrinking machine for woolen fabrics, an instrument for perspective drawing, a micro "stop" motor, and a knife for stripping insulation are described and illustrated.

"Engineered Special Hazard Fire Protection." Bulletin No. 73. Automatic Sprinkler Corp. of America, Youngstown, O. 26 pages. This illustrated catalog describes the firm's various automatic sprinkler systems for many kinds of industrial sites and chemical equipment.

"Progress Report on the Cooperative *Hevea* Rubber Development Program in Latin America." Circular No. 976. United States Department of Agriculture, Washington, D. C. 82 pages. Price, 35c. United States efforts to assist Latin American nations in the development of a natural rubber industry, first begun in 1940, are described in this illustrated booklet.[1]

[1]See India RUBBER WORLD: 104, 35, 45 (1941); 106, 239, 350, 461 (1942); 108, 143 (1943); 112, 451 (1945); 116, 491 (1947).

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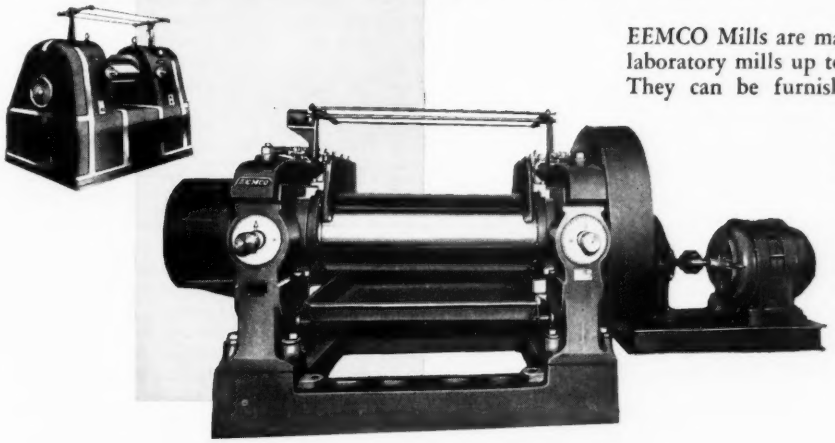

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"Synpol." Texas-U. S. Chemical Co., New York, N. Y. 4 pages. A listing of current grades of the company's Synpol rubbers is contained in this sales folder.

"Radioisotope Catalog." Union Carbide Nuclear Co., Oak Ridge National Laboratory, radioisotope sales department, Oak Ridge, Tenn. Specifications of about 100 radioactive preparations made and distributed by the National Laboratory are contained in this catalog.

"SM-33," "SM-55," "SM-61." General Electric Co., silicone products department, Waterford, N. Y. 3 pages each. The properties and applications of these silicone emulsions, each an oil-in-water emulsion of a methyl silicone fluid, are contained in these data sheets. SM-33 is similar to SM-61, but provides greater lubricity. Specific uses for SM-55 are said to include rubber and plastics molding, the treatment of textiles, and the impregnation of gaskets to prevent sticking.

Publications of Office of Technical Services, United States Department of Commerce, Washington, D. C.:

"Development of Room-Temperature-Curing Structural Adhesives for Metals." Report PB 111764. 89 pages. Price, $2.25. This publication describes the development, formulation, and processing of a methacrylic acid-methyl methacrylate adhesive for the fabrication and field repair of certain airframe structural parts where the use of heating and pressurizing equipment would be impracticable or impossible. The research was done for the U. S. Air Force by Bjorksten Research Laboratories.

"Patent Abstract Series Supplement." PB 111854. 134 pages. Price, $3.75. The latest in the OTS "Patent Abstract Series," this volume lists the 905 patents acquired by the government from January, 1954, to June, 1955, all available royalty-free. PB 111470, "Ceramic, Paper, Rubber, Textile, Wood and Other Products and Processes," an earlier compilation, is available from the same source for $1.

"Shelf Life of Neoprene-Coated Nylon Fabrics." PB 111728. 18 pages. Price, 75¢. The results of U. S. Navy research into the shelf-life of lightweight neoprene-coated nylon fabrics are reported in this publication. Except for a small loss in tear strength after a four-year storage, no change was noted in the properties of the materials.

"Development of a Rubber for High-Temperature Service in Contact with Experimental Hydraulic Fluids." PB 111766, 18 pages. Price, 50¢. This is a report of Air Force research evaluating various commercial and experimental rubber compounds for high-temperature use in contact with newly developed hydraulic fluids. The results indicated that present elastomer compounds are incapable of service in the fluids for more than 48 hours at 400° F.

"Effects of Radiation on Dielectric Materials." PB 111863. 171 pages. Price, $4.25. This book consists of papers submitted at a Naval Research Laboratory conference in December, 1954, on the effects of radiation on dielectric materials. Included are such subjects as radiation stability of polymers, concepts of radiation chemistry, a survey of the chemistry of polymer formation, effects on glass, conductivity of polyethylene and Teflon during irradiation, and an evaluation of the effects of radiation on organic materials.

"ASTM Standards on Plastics." 1955 Edition. American Society for Testing Materials, Philadelphia, Pa. Paper cover, 6 by 9 inches, 790 pages. Price, $5.75 ($4.40 to members). This revised edition presents ASTM standards and tentative specifications, methods of analysis, methods of physical testing, recommended practices, and definitions of terms pertaining to plastics. Specifications and tests total 143, of which four are new and 41 have been revised or raised to standard status.

"Meriam Manometers." Bulletin G-10. The Meriam Instrument Co., Cleveland, O. 4 pages. The company's manometers for measuring pressures, vacuums, flows, and liquid levels are pictured and described in this brochure.

"Epolene." Eastman Chemical Products, Inc., Kingsport, Tenn. 22 pages. Properties and applications of the company's polyethylene waxes are contained in this booklet.

"Paracril Cements." W. E. Galwardy and L. F. Pieroth. Technical Bulletin No. 9. Naugatuck Chemical Division of United States Rubber Co., Naugatuck, Conn. 20 pages. The compounding of nitrile rubber solvent cements for use where oil resistance and good adhesive characteristics are required is discussed in this booklet. Typical formulations, compounding techniques, and test data are included.

"Hycar Technical Newsletter." Vol. V. No. 1. B. F. Goodrich Chemical Co., Cleveland, O. 8 pages. Discussed in this issue are the compounding of resilient Hycar vulcanizates, the removal of Hycar and Hycar-phenolic cements from metals, and sample Hycar formulations for meeting the requirements of Class SC of ASTM Standard D735.

"Analog to Digital Conversion in Automatic Weighing." Technical Reference No. 55B. Richardson Scale Co., Clifton, N. J. 2 pages. A description and photographs of the firm's semi-continuous weigher for providing a cumulative indication of pounds of material weighed as the weigher discharges are contained in this publication. The equipment is said to be ideal for non-free-flowing adhesive materials.

"Progress through Research." Armour Research Foundation. Illinois Institute of Technology, Chicago, Ill. 58 pages. This report of the Foundation's work during 1955 describes such projects of interest to the rubber industry as the development of a cheap, steam-resisting rubber stock; the study of fractions from high-temperature coke-oven light oil and resins made from them; the preparation of a handbook for calculating friction losses across certain plastic piping; a study of periodic tire noises; and an investigation of techniques and apparatus for the dynamic evaluation of rubber.

"Ross Industrial Dryers." Bulletin No. 54. J. O. Ross Engineering Corp., New York, N. Y. 4 pages. Some of the company's industrial dryers for such materials as foam rubber, plastic-treated goods, pressure-sensitive tape, nylon tire cord, and fiber glass molded parts are pictured and described in this brochure.

Publications of the British Rubber Producers' Research Association, Welwyn Garden City, Herts., England:

No. 215. **"Large Elastic Deformations of Isotropic Materials**—Part X. Reinforcement by Inextensible Cords." J. E. Adkins and R. S. Rivlin. 24 pages. The theory of large elastic deformations of incompressible, isotropic materials developed in previous papers of this series is here employed to examine some simple deformations of elastic bodies reinforced with cords.

No. 216. **"A Versatile Absolute Rotating Cylinder Plastometer."** P. Mason and L. M. Smith. 6 pages. The construction and the method of use of a rotating cylinder plastometer with a wide annulus are described here. Examples of application to the study of rubber-bitumen systems are given.

No. 217. **"Mastication of Rubber**—Part II. Interpolymerization of Natural Rubber and Neoprene on Cold Milling." D. J. Angier and W. F. Watson. 10 pages. Described here is a general method of producing graft and block interpolymers between natural rubber and neoprene by cold milling the polymers together in the absence of small molecules which can terminate the polymeric radicals in order that the radicals may cross-terminate or graft on to the polymer molecules of the other type.

No. 221. **"Crystallization in Natural Rubber: Part IV,** Temperature Dependence." A. N. Gent. 14 pages. This portion of this research project describes experiments in which the temperature dependence of crystallization in natural rubber, unvulcanized and vulcanized by a peroxide, was investigated dilatometrically over the temperature range of —37 to 0° C. It is shown that the classical nucleation theory describes the temperature dependence to a first approximation. The retardation of crystallization caused by the introduction of cross-links is ascribed partly to a reduction in chain segment mobility and partly to prohibition of crystal nucleus formation about each cross-link.

"Gas and Oil Equipment List." November, 1955. Underwriters' Laboratories, Inc., Chicago, Ill. 292 pages.

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MARKET REVIEWS

Natural Rubber

Natural rubber prices on both the spot and futures markets continued to fall during the first half of the February 16-March 15 period, but some recovery was effected in the early part of March. In spot trading, the #1 grade of R.S.S. declined steadily from a period-high of 37.50¢ on February 16 to 33.63¢ on March 1, a differential of almost 4¢ a pound. A sudden spurt shot the grade up to 35.75¢, and the period ended at 35.00¢, with a certain indication of steadiness. Trading on the New York Commodity Exchange was about normal.

Observers attributed the continued decline in the price structure to rumors that the British Government would severely reduce the volume of buying for its natural rubber stockpile in line with its overall anti-inflationary program. The rumors so far have been neither affirmed nor denied, but they nonetheless evoked bitter comments in Singapore and Malaya, causing nervousness on the market. Another depressing factor was heavy selling in the Far East, representing, according to some sources, hedging by dealers in the Far Eastern market against stocks there.

The sudden strengthening of the market at the beginning of March was seen to have resulted from both President Eisenhower's announcement that he would run again and the unexpected heavy United States rubber consumption in January revealed by the Department of Commerce. Heavy Soviet buying in the Far East was believed to be another factor. A rumor that the United States would assent to the lifting of the embargo on rubber shipments to Red China was subsequently denied by American spokesmen.

There were no logical indications of how the market would go during the latter part of March and in April, but some observers believed the price decline had tapered off.

COMMODITY EXCHANGE
WEEK-END CLOSING PRICES

Futures	Jan. 20	Feb. 17	Feb. 24	Mar. 2	Mar. 9
Mar.	40.40	34.80	33.30	32.60	33.90
May	37.37	34.35	33.25	32.90	34.10
July	36.05	33.40	32.35	31.85	33.20
Sept.	34.95	32.70	32.00	31.40	32.55
Dec.	33.80	31.85	31.50	30.80	32.00
Total weekly sales, tons	13,470	13,030	15,380	15,490	13,320

Statistically, on the New York Commodity Exchange, sales for the second half of February were 32,320 tons, bringing the monthly total to 61,490 tons. Sales during the first half of March were 30,640 tons. Sales during the February 16-March 15 period were 62,960 tons.

March stocks began the period at 36.25¢ for the #1 grade and were at 33.50¢ on March 15. December stocks began at 32.75¢ and were 31.55¢ on the 15th. There were 20 trading days during the period.

On the physical market, February monthly spot prices for representative grades were as follows: R.S.S. #1, 37.75¢; R.S.S. #3, 37.09¢; #3 Amber Blankets, 33.40¢; and Flat Bark, 26.13¢. For the first half of March, R.S.S. #1 averaged 34.96¢.

NEW YORK SPOT MARKET
WEEK-END CLOSING PRICES

	Jan. 20	Feb. 17	Feb. 24	Mar. 2	Mar. 9
R.S.S.: #1	41.13	36.75	35.00	33.88	35.13
2	40.88	36.25	34.75	33.63	35.00
3	40.75	36.00	34.50	33.38	34.88
Latex Crepe					
#1 Thick	44.75	40.00	38.25	38.25	39.00
Thin	44.75	40.00	38.25	38.25	39.00
#3 Amber Blankets	34.38	33.00	32.38	32.13	31.88
Thin Brown Crepe	33.88	32.63	32.00	31.88	31.50
Flat Bark	27.38	26.00	25.25	24.88	24.88

Synthetic Rubber

The American synthetic rubber industry continues to hurtle toward new records, with two new plant expansions announced in March, an all-time high production figure revealed for January, and at least one prediction that world consumption this year would top every previous figure.

Phillips Chemical Co. has begun construction at its Borger, Tex., plant that by mid-1957 will raise production capacity 88%, from the current 63,000 long tons to 108,000 long tons. A 50% capacity increase at its Louisville, Ky., plant was announced by American Synthetic Rubber Corp. that will boost its production from a current 44,000 long tons to 68,000 long tons by early 1957.

In view of the rampant optimism of the industry, the cost of the two expansions is seen to be a gilt-edged investment. Goodrich President W. S. Richardson allied himself with the realist-optimists early in March by predicting that world consumption of man-made rubbers in 1956 would exceed the 1955 total by 100,000 tons, a 10% increase. The forecast was made despite the probability that the use of new rubber of all types by American manufacturers would drop about 4% this year because of the cutback in auto output.

As revealed by the United States Department of Commerce and The Rubber Manufacturers Association, January production of synthetic rubber set a new record of 93,485 tons; while consumption totaled 79,414 tons. February production and consumption figures dropped to 90,457 and 75,377 tons, respectively, but this decline was mostly due to the shorter month.

Export firms contributed to the air of optimism by voicing bitter complaints about their inability to obtain enough synthetic rubber to meet foreign orders. The complaints were made despite the rise in February exports to 11,050 tons from the 10,179 tons exported in January.

The young industry, sensitive to market requirements and technical developments, continued in a state of flux during March by dropping certain grades from production schedules, particularly GR-S types, and adding new ones. Modifications to grades carrying old government designations also went on apace, causing one harried researcher to mutter that soon any resemblance of American synthetic rubber to the former GR-S numbers would be purely coincidental.

Prices remained the same during the February 16-March 15 period, but some quarters expect boosts by mid-year.

Latex

The continued fall in the price of *Hevea* latex during the period from February 16 to March 15 did not induce consumers to buy in any undue volume. Stocks were seen to be very strong, and it was evident that consumers did not see the need of strengthening them at this time. Producers complained that the *Hevea* latex premium had declined to a very bare economic level. Although some foreward positions were being strengthened, near orders were particularly slow in coming in.

One observer, believing consumers were being too optimistic, predicted that stocks would fall to alarmingly low levels during the third quarter of the year unless more immediate buying would be done.

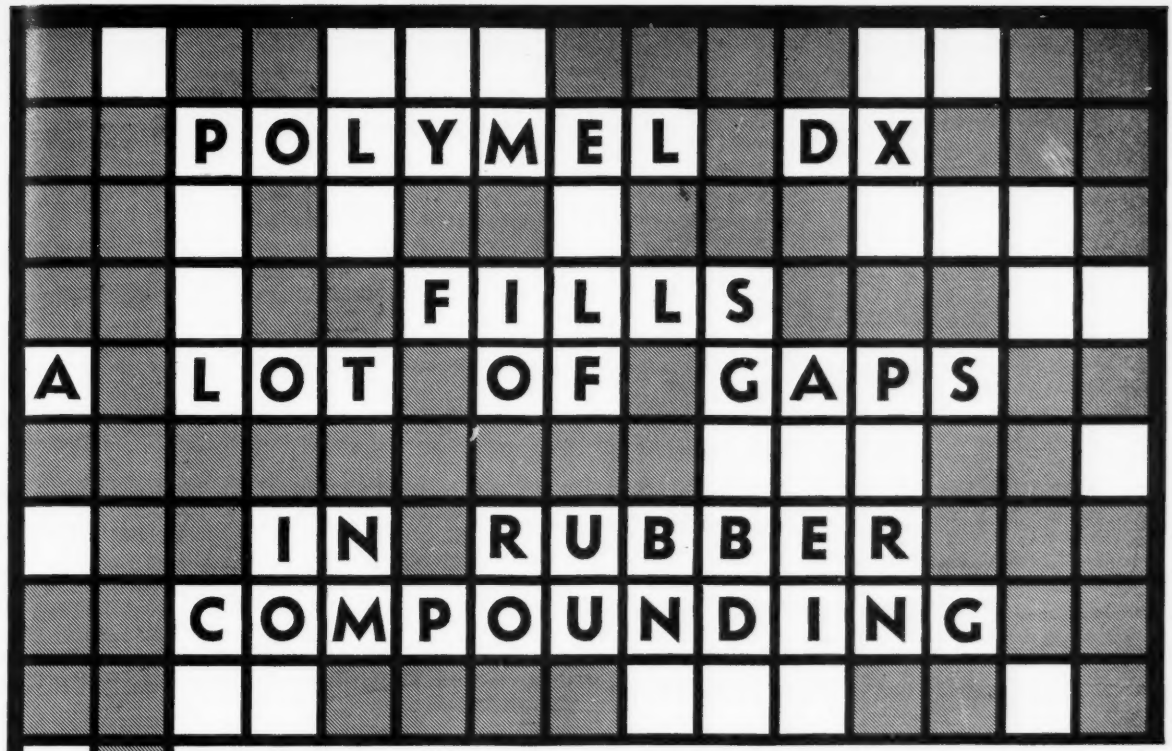
Current stocks of synthetic latices were also seen to be strong as high consumption and production continued.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b. rail tank cars, ranged during the period from 40 to 45¢ per pound solids. Prices of synthetic latices remained the same, being quoted as: GR-S type, 26-32.3¢; neoprene, 37-47¢; and N-type, 46-54¢.

Final December and preliminary January domestic statistics for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Dec.	0	6,364	6,344	12,628
Jan.	0	....	6,567	15,755
GR-S				
Dec.	6,352	55	5,599	6,480
Jan.	6,770	115	6,126	6,695
Neoprene				
Dec.	1,004	0	717	1,236
Jan.	848	0	781	1,078
Nitrile				
Dec.	874	0	587	1,282
Jan.	919	0	725	1,357



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NO. 4
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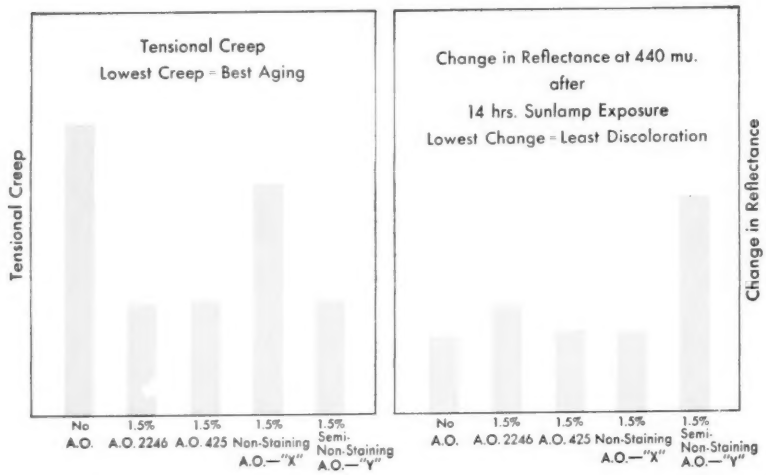
Published by **AMERICAN CYANAMID COMPANY**, Rubber Chemicals Department, Bound Brook, New Jersey



Rubber stocks containing no antioxidant, and those containing uniform percentages of each of four antioxidants, register varying degrees of resistance to aging and discoloration, as shown above. In both comparative tests, Antioxidant 2246 and Antioxidant 425 provided the best *combined* resistance to aging and discoloration.

Effective Antioxidation Without Discoloration

New uses are being found for products made from rubber every day. Many of these products are designed for use in homes and cars, and as wearing apparel. For such uses the normal black product is usually too drab and does not blend well with the light pastel shades and whites so popular today. This requires that rubber products also be in white or light shades.

These light-colored rubber products must be designed to age well. And since the well-known antioxidants used with black products will discolor or stain, the need for a non-discoloring, yet strong antioxidant is apparent.

Antioxidant 2246® fills this need consistently. It gives excellent protection against oxidation and heat deterioration. In addition, discoloration is minimized and staining is almost nonexistent. The wide acceptance of Antioxidant 2246 in the rubber trade is a testimonial to its value.

However, under certain conditions and in some applications, even the low discoloration tendencies of Antioxidant 2246 are not sufficient. To solve this problem, Antioxidant 425® was developed. Antioxidant 425 causes little or no more discoloration than when no antioxidant is used at all – yet very little, if any, sacrifice is made in its power as an age resistor.

Here, as the charts above show, are two antioxidants for white and light-colored rubber products which offer excellent protection against aging and at the same time keep discoloration at a minimum.

For technical information on Antioxidant 2246, write for Rubber Chemicals Technical Bulletin No. 815; for technical information on Antioxidant 425, write for Rubber Chemicals Technical Bulletin No. 840.

Chemical Progress in Antioxidants

Since 1924, when the first U.S. patent covering age-resistors was issued, many different products have been tried as antioxidants. Today there are about 50 different chemicals in use.

The first really active antioxidants were reaction products of aliphatic aldehydes and primary aromatic amines, known as aldehydeamines. These were soon followed by the secondary aromatic amines such as phenylbetanaphthylamine and ketone-amine reaction products, represented by acetone-aniline reaction products and acetone-diphenylamine reaction products.

Phenylbetanaphthylamine and diphenylamine-acetone reaction products are outstanding antioxidants. However, they discolor rubber badly, particularly when the rubber product is exposed to light, so that they can only be used in black or dark-colored rubber products.

White and light-colored rubber products oxidize in storage or in use. This shortens their service life. In the last 30 years much progress has been made in developing antioxidants which will give minimum discoloration on exposure to light. These materials are usually called "non-staining" or "non-discoloring" antioxidants. The best of them belong to the class of chemicals known as phenols. This is an expanding class of antioxidants, and a number of new chemicals have been added to the list in recent years. Some of these phenolic-type antioxidants give practically no discoloration when the white or light-colored rubber product is exposed to light, but they have little activity as antioxidants. In the last 10 years a number of bis (dialkyl phenols) have been found to be powerful antioxidants which give very little or no discoloration.

Cyanamid has contributed to chemical progress in recent years with the development of Antioxidants 2246 and 425, and through continuing research will develop others.

Chemical Progress Means Rubber Progress

CHEMICAL PROGRESS WEEK-APRIL 23-28

Scrap Rubber

Fair activity prevailed on the scrap rubber market during the period from February 16 to March 15, with demand for mixed auto tires and truck tires particularly good. Orders for tubes, especially butyls, were considerably off.

Exports of scrap rubber declined during November, according to the Census Bureau of the U. S. Department of Commerce. November shipments totaled 3,689,106 pounds, valued at $99,353; while exports in October had reached 4,446,516 pounds worth $163,398. For the first 11 months of 1955 scrap rubber exports amounted to 33,932,951 pounds, valued at $1,148,674. Scrap rubber exports in all of 1954 totaled 30,558,059 pounds worth $763,228.

During the February 16-March 15 period, price increases were noted for mixed auto tires, S. A. G. truck tires, and No. 3 peelings. Mixed auto, red, and butyl tubes declined.

Period-end prices were as follows:

	Eastern Points (Per Net Ton)	Akron, O. (Per Net Ton)
Mixed auto tires	$14.00/16.00	$16.50
S.A. G. auto tires	Nom.	Nom.
Truck tires	14.00	17.00
Peelings, No. 1	41.00/42.00	41.00/42.00
2	23.00	24.00/25.00
3	16.00	19.00
Tire buffing	14.00	14.00/15.00
	(¢ per Lb.)	
Auto tubes, mixed	3.75	3.75
Black	5.75	5.50
Red	6.50	6.50
Butyl	Nom.	Nom.

Reclaimed Rubber

The reclaimed rubber market slowed somewhat during the period from February 16 to March 16, owing primarily to cutbacks in the automotive industry. According to one industry spokesman, however, orders already on hand indicate that the following period will show a considerable increase in business activity. Whether this higher level would be maintained for the remainder of the year was seen to be problematical.

Figures released by the United States Department of Commerce reveal that 312,781 tons of natural and synthetic reclaimed rubber were consumed in this country during 1955, compared to 249,049 tons in 1954.

Current market prices of reclaimed rubber follow:

RECLAIMED RUBBER PRICES

	Lb.
Whole tire: first line	$0.105
Fourth line	.0925
Inner tube: black	.15
Red	.21
Butyl	.155
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Cotton Fabrics

A quiet but firm tone continued to characterize the industrial fabrics market during the period from February 16 to March 15. Wide industrial fabrics, including sateens, broken twills, and drills, displayed a somewhat better tone than previous trading due to expectations that the automotive industry would require more goods in the weeks ahead. Wide drills, especially, were being sold in substantial quantities for delivery in the second quarter of the year.

Trading in most cotton ducks was generally slow during the period, but mills were said to have sizable order backlogs in most constructions, extending into May. Army ducks are particularly well sold and in tight supply for April shipment.

Second-hand goods have continued to flow on to the market. These have included wide drills, sateens, and broken twills.

Technologists of the Quartermaster Research & Development Command and the Industry Advisory Committee to the Quartermaster General on Coated Fabrics met recently at the Philadelphia Quartermaster Depot to discuss coated fabrics development and specifications for coated fabric items. Results of the conclave have yet to be revealed, but they should have some influence on the course of the industrial fabrics market in the near future.

Price changes were mixed during the period. The 38-inch, 2.00-yd. D.F. ducks rose 1¢ a yard; while some printcloths rose fractionally. A decrease of 1¢ a yard was noted for 59-inch 1.85 yd. drills; while the 59-inch 2.25 yd. drills fell fractionally.

COTTON FABRICS

Drills		
59-inch 1.85 yd.	*yd.*	$0.39
2.25-yd.		.33/.335
Ducks		
38-inch 1.78-yd. S.F.	*yd.*	nom.
2.00-yd. D.F.		.34
51.5-inch, 1.35-yd. S.F.		.4963
Hose and belting		.69
Osnaburgs		
40-inch 2.11-yd.	*yd.*	.265
3.65-yd.		.1675
Raincoat Fabrics		
Printcloth, 38½-inch, 64x60, 5.35-yd.	*yd.*	.15
6.25 yd.		.1275
Sheeting, 48-inch, 4.17-yd.		.20
52-inch, 3.85-yd.		.24
Chafer Fabrics		
14.40-oz./sq. yd. Pl.	*yd.*	.70
11.65-oz./sq. yd. S.		.61
10.80-oz./sq. yd. S.		.6575
8.9-oz./sq. yd. S.		.67
Other Fabrics		
Headlining, 59-inch, 1.65-yd., 2-ply	*yd.*	.465
64-inch, 1.25-yd., 2-ply		.595
Sateens, 53-inch, 1.32-yd.		.5675
58-inch, 1.21-yd.		.62

Rayon

Total calculated production of rayon and acetate yarn during January was 76,300,000 pounds, of which 39,600,000 pounds were regular-tenacity yarn, and 36,700,000 pounds were rayon high-tenacity yarn. February production was: total, 69,000,000 pounds; regular-tenacity, 34,400,000 pounds, and high-tenacity, 34,600,000 pounds.

Total domestic shipments for January were 78,000,000 pounds, consisting of 42,400,000 pounds of regular-tenacity yarn and 35,600,000 pounds of rayon high-tenacity yarn. February shipments were: 70,500,000 pounds; regular-tenacity, 36,400,000 pounds; and high-tenacity, 34,100,000 pounds.

Total end-of-January stocks were 49,000,000 pounds, of which 41,400,000 pounds were regular-tenacity yarn, and 7,600,000 pounds were high-tenacity rayon yarn. End-of-February stocks were: total, 46,100,000 pounds; regular-tenacity, 38,700,000 pounds; and high-tenacity, 7,400,000 pounds.

Rayon and acetate prices have now been raised 3-5¢ a pound by all sections of the industry.

RAYON PRICES

Tire Yarns	
High-Tenacity	
1100/ 480	$0.67
1100/ 490	.67
1150/ 490	.67
1165/ 480	.68
1230/ 490	.67
1650/ 720	.64
1650/ 980	.64
1875/ 980	.64
2200/ 960	.63
2200/ 980	.63
2200/1466	.67
4400/2934	.63
Super-High-Tenacity	
1650/ 720	.69
1900/ 720	.69
Tire Fabrics	
1100/490/2	.77
1650/980/2	.725
2200/980/2	.715

Nylon, Dacron Prices Cut

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has reduced by 10-22% the price of its nylon filament yarns and by 14-30% the price of its Dacron polyester fiber filament yarns. The move is intended to stimulate and widen the markets for both products. Only the domestic price schedule is affected.

The price of 840-denier high-tenacity nylon, used for tire cord, was reduced from $1.48 to $1.30 a pound.

Chemstrand Corp., the nation's other producer of nylon yarn, has followed the du Pont reductions in its own price schedule.

RCA Latex Storage Plans

Rubber Corp. of America, Hicksville, N. Y., has entered into an agreement with the Georgia Ports Authority calling for the construction of a bulk storage installation for natural rubber latex at the Port of Savannah. Completion of the facilities is expected by June.

STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

Year	Natural	GR-S	S-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1949	660,792	288,882	21,717	54,046	35,215	11,072	1,071,724
1950	802,249	350,801	28,086	60,915	50,067	12,037	1,304,155
1951	733,048	694,583	9,946	76,475	58,907	15,333	1,588,292
1952	805,997	636,969	17,885	81,630	65,745	16,228	1,624,454
1953	647,615	668,386	12,342	79,801	80,495	20,198	1,508,837
1954	596,848	472,698	17,707	58,802	69,150	21,396	1,236,601
1955							
Jan.	49,941	57,607	1,436	3,220	6,983	2,215	121,402
Feb.	50,880	55,293	1,149	3,727	6,910	1,659	119,618
Mar.	61,250	63,940	1,229	5,256	7,132	2,409	141,216
Apr.	61,113	50,745	10,081	5,148	8,359	2,433	137,879
May	61,042	3,592	63,220	5,115	7,852	2,720	143,541
June	52,762	3,739	61,717	3,872	5,919	3,422	131,431
July	43,626	1,640	64,910	5,395	6,904	3,195	125,670
Aug.	59,840	....	68,898	4,203	8,511	2,792	144,244
Sept.	50,459	....	68,228	5,097	7,677	2,821	134,282
Oct.	45,720	....	73,103	5,501	8,118	2,958	135,400
Nov.	50,509	....	75,745	4,935	8,537	2,931	142,657
Dec.	48,032	....	74,813	4,710	8,455	3,068	139,078
Total	635,174	236,556	564,589	56,179	91,357	32,623	1,616,478
1956							
Jan.*	....	....	76,163	6,896	8,207	3,055	.....

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

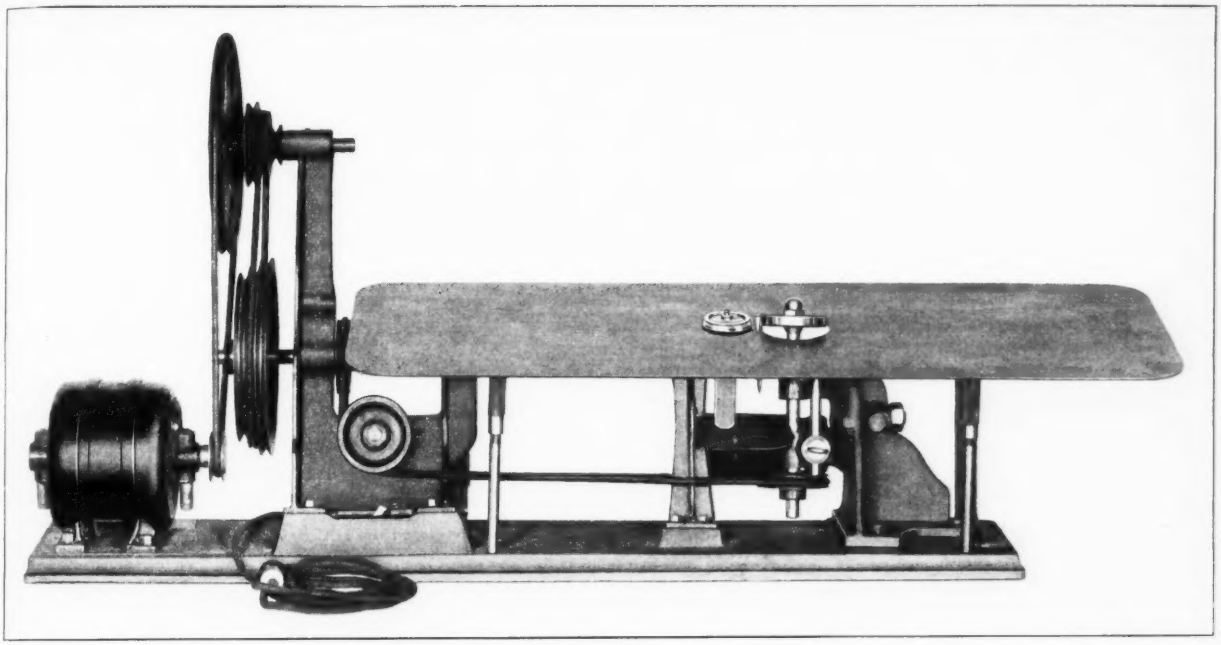
U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	S-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1949	574,522	299,420	21,717	52,664	31,753	8,827	988,903
1950	720,268	388,427	27,803	66,348	43,781	11,930	1,258,557
1951	454,015	617,200	9,244	70,500	48,887	13,066	1,212,912
1952	453,846	648,816	17,604	71,229	55,522	13,866	1,260,883
1953	553,473	611,748	12,433	77,826	65,900	16,929	1,338,309
1954							
Jan.	46,960	37,707	982	5,438	4,774	1,272	97,133
Feb.	46,897	36,765	942	5,696	4,467	1,190	95,957
Mar.	53,709	42,074	1,062	6,300	5,177	1,447	109,769
Apr.	51,451	40,194	1,130	6,241	4,684	1,395	105,105
May	51,398	40,030	1,144	5,602	4,486	1,366	104,026
June	54,253	43,782	1,192	5,961	4,769	1,491	111,448
July	37,894	31,474	1,326	4,108	3,499	1,145	79,446
Aug.	38,069	30,800	1,596	3,569	4,647	1,439	80,120
Sept.	52,412	40,204	1,994	5,138	5,049	1,493	106,290
Oct.	55,970	45,002	2,061	4,711	4,931	1,604	114,279
Nov.	53,326	44,429	1,980	3,967	5,276	1,635	110,613
Dec.	55,096	50,540	1,935	4,583	5,434	1,638	119,226
Yr.-end adj.	− 1,150	....	....	+ 150	....	+ 600	....
Total	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955							
Jan.	56,911	54,728	1,643	4,478	5,676	1,931	125,367
Feb.	50,997	54,707	1,293	4,312	5,476	1,921	118,706
Mar.	58,472	62,548	1,189	4,839	6,423	2,174	135,645
Apr.	52,963	54,091	5,655	4,321	5,884	2,172	125,086
May	54,746	2,533	60,325	4,455	6,143	1,965	130,167
June	56,282	3,666	62,226	4,704	6,320	2,581	135,779
July	46,166	2,690	50,398	3,894	4,294	1,621	109,063
Aug.	48,359	....	59,746	4,307	6,450	2,219	121,268
Sept.	50,963	....	63,330	4,578	6,197	2,270	127,338
Oct.	54,995	....	66,744	4,739	6,626	2,280	135,374
Nov.	52,769	....	68,111	4,420	6,896	2,234	134,430
Dec.	48,377	....	63,149	4,219	6,491	2,167	124,403
Yr.-end adj.	+2,800	....	+3,225	+725	....	+500	+7,250
Total	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956							
Jan.*	....	....	66,062	4,283	6,698	2,371	....

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

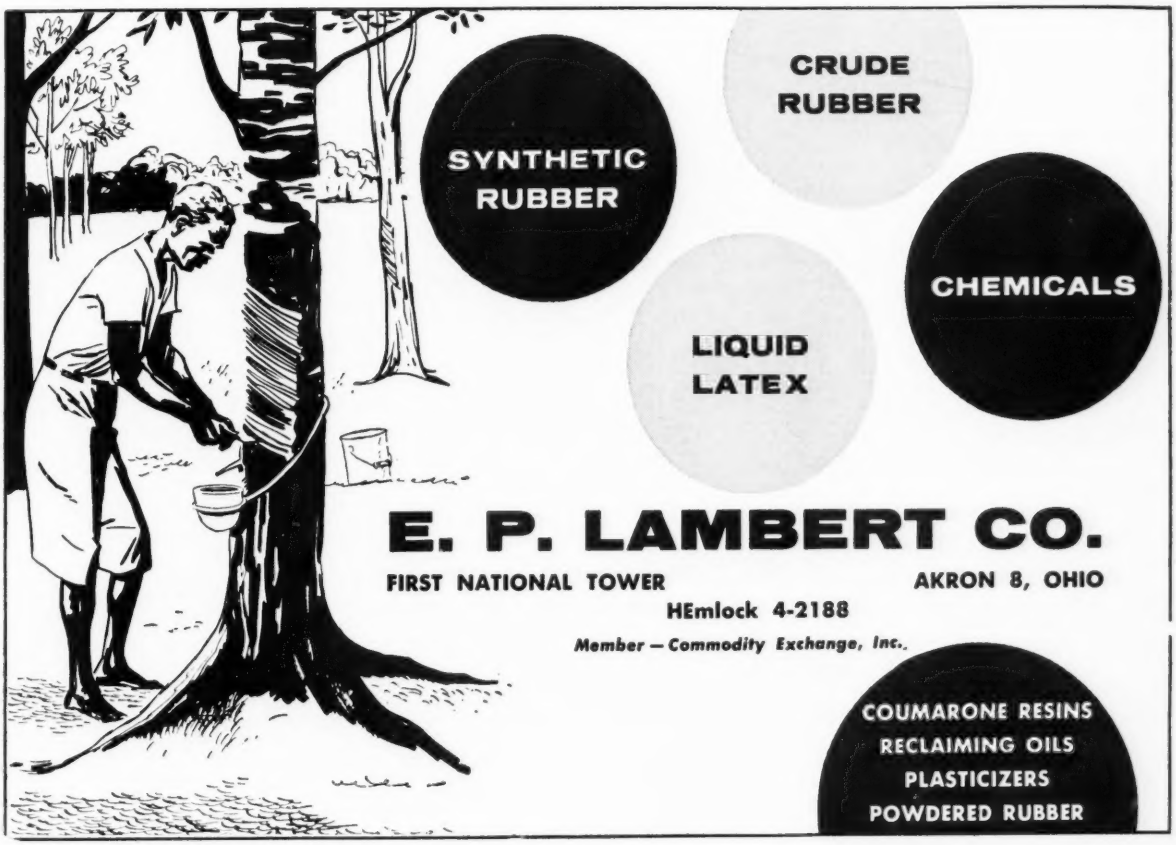
TW MORRIS TRIMMING MACHINES

The World's Trimmers



#10 Inside and Outside Trimmer

TW MORRIS TRIMMING MACHINES
◄ 6301 WINTHROP AVENUE
CABLE "MORTRIM" ◄ CHICAGO 40, ILL., U. S. A.



U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1943	3,638	....	....	....	....	5,638
1944	2,443	....	....	....	....	2,443
1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955						
Jan.	9,684	5,861	1,067	812	7,740	17,424
Feb.	8,619	5,753	879	692	7,324	15,943
Mar.	7,820	6,940	909	658	8,507	16,327
Apr.	6,790	7,098	786	725	8,609	15,399
May	8,854	7,021	767	842	8,630	17,484
June	9,788	6,645	817	958	8,420	18,208
July	11,934	6,950	850	1,155	8,955	20,889
Aug.	11,962	6,201	885	1,076	8,162	20,124
Sept.	12,595	6,448	975	1,296	8,719	21,314
Oct.	12,156	5,798	1,075	1,196	8,069	20,225
Nov.	12,616	6,307	1,089	1,174	8,570	21,186
Dec.	12,628	6,480	1,236	1,282	8,998	21,626
Yr.-end adj.	+575	+500	....	+525	+1,025	+1,600
	13,203	6,980	1,236	1,807	10,023	23,226
1956						
Jan.†	15,755	6,695	1,078	1,357	9,130	24,885

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes S-Types.
† Preliminary.

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1946	8,012	24,810	13,595	....	38,405	46,417
1947	17,675	22,474	6,089	....	28,563	46,238
1948	32,630	21,494	5,022	....	26,516	59,146
1949	29,974	21,357	3,651	....	25,008	54,982
1950	54,401	31,339	5,725	....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955						
Jan.	7,853	6,199	617	708	7,524	15,377
Feb.	6,110	5,634	797	525	6,956	13,066
Mar.	7,611	7,078	854	738	8,670	16,281
Apr.	8,550	5,680	975	972	7,627	16,177
May	8,849	5,337	880	815	7,032	15,881
June	7,736	4,777	905	1,450	7,132	14,868
July	8,702	4,800	641	951	6,392	15,094
Aug.	8,885	4,519	881	1,010	6,410	15,295
Sept.	8,109	5,769	994	1,091	7,854	15,963
Oct.	6,900	6,231	922	883	8,036	14,936
Nov.	7,085	6,933	1,004	781	8,718	15,803
Dec.	6,364	6,407	962	874	8,243	14,607
Total	92,754	69,364	10,432	10,798	90,594	183,348
1956						
Jan.†	.....	6,885	848	919	8,652	.....

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes S-Types.
† Preliminary.

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	S-Types	Butyl	Neoprene	N-Type	Total
1943	36,395	1,033	6,644	3,223	47,295
1944	122,412	9,992	12,262	5,366	150,032
1945	170,571	18,378	9,703	4,802	203,454
1946	83,090	19,478	10,470	3,755	116,793
1947	40,606	13,184	5,237	3,339	62,366
1948	96,304	10,995	5,072	2,762	115,133
1949	77,743	12,224	4,654	3,433	98,054
1950	36,942	7,243	5,733	2,840	52,758
1951	105,271	12,481	8,379	3,821	129,952
1952	83,861	22,716	8,535	3,875	118,987
1953	135,153	24,866	11,480	4,346	175,845
1954					
Jan.	138,692	24,733	13,065	4,349	180,839
Feb.	143,202	23,573	12,518	4,112	183,405
Mar.	145,178	22,329	12,575	4,202	184,284
Apr.	136,446	21,673	12,665	4,199	174,983
May	131,604	20,077	11,467	4,435	167,583
June	124,678	17,534	10,646	4,314	157,172
July	128,752	18,150	11,315	4,727	162,944
Aug.	135,164	19,672	10,710	4,613	170,159
Sept.	128,313	18,513	10,288	4,548	161,662
Oct.	127,204	18,653	11,038	4,272	161,167
Nov.	121,772	19,338	11,429	4,366	156,905
Dec.	115,499	19,267	11,349	4,280	150,395
1955					
Jan.	114,976	17,079	11,598	4,121	147,774
Feb.	111,796	15,424	10,555	3,888	141,663
Mar.	113,594	15,096	11,037	3,860	143,587
Apr.	112,156	14,813	10,863	3,612	141,444
May	109,381	14,449	10,283	3,995	138,108
June	103,844	13,053	9,755	4,042	130,694
July	110,281	13,288	11,213	5,120	139,902
Aug.	108,211	12,395	11,326	5,118	137,050
Sept.	107,641	12,190	11,209	4,995	136,035
Oct.	105,746	12,146	11,820	5,041	134,753
Nov.	105,287	11,646	11,530	5,201	133,664
Dec.	108,339	10,180	12,220	5,580	136,319
Yr.-end adj.	+650	+320	.....	+450	+1,420
	108,989	10,500	12,220	6,030	137,739
1956					
Jan.*	112,186	12,312	11,843	5,920	142,261

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1946	295,612	275,410	14,461	33,666
1947	291,395	288,395	14,556	35,943
1948	266,861	261,113	11,428	32,630
1949	224,029	222,679	10,367	28,263
1950	314,008	303,733	11,740	35,708
1951	366,700	346,121	14,722	45,082
1952	274,981	280,002	11,180	30,664
1953	298,336	285,050	11,397	32,319
1954				
Jan.	20,026	19,114	912	31,865
Feb.	21,122	19,461	941	32,393
Mar.	23,383	22,882	830	32,148
Apr.	21,658	21,883	1,050	31,359
May	21,316	20,436	1,071	31,105
June	22,342	22,321	1,068	30,845
July	18,041	16,301	586	31,304
Aug.	15,519	17,660	647	27,692
Sept.	22,352	19,926	641	29,632
Oct.	23,566	22,098	808	30,395
Nov.	22,986	22,321	862	29,451
Dec.	25,790	24,546	816	30,746
Total	258,101	249,049	10,232	.....
1955				
Jan.	25,336	25,322	1,041	29,656
Feb.	25,444	24,333	1,085	30,125
Mar.	29,574	28,674	1,088	30,311
Apr.	26,817	26,609	1,088	30,068
May	27,911	27,652	1,056	29,528
June	30,451	29,157	1,128	29,725
July	24,114	22,563	1,176	29,939
Aug.	25,223	25,790	1,144	27,956
Sept.	26,512	26,340	1,018	27,110
Oct.	28,038	26,597	1,381	27,565
Nov.	29,124	27,229	1,313	28,473
Dec.	28,105	24,515	1,470	31,058
Year.-end adj.	.....	—2,000	.....	+440
Total	326,649	312,781	13,988	31,498
1956				
Jan.*	26,211	26,119	1,392	31,994

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

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U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	S-Types	Butyl	Neoprene	N-Type	Total
1945	76,555	980	5,837	406	83,778
1946	68,763	495	2,642	797	72,697
1947	7,951	62	2,617	755	11,385
1948	1,093	21	2,875	885	4,874
1949	1,401	178	3,330	1,574	6,483
1950	900	31	4,826	1,895	7,652
1951	483	216	6,825	1,725	9,249
1952	9,467	126	9,813	2,695	22,101
1953	7,692	237	11,494	3,245	22,668
1954	11,069	2,831	12,062	4,155	30,117
1955					
Jan.	1,381	716	1,046	194	3,337
Feb.	1,331	370	1,049	259	3,009
Mar.	2,162	672	1,287	236	4,357
Apr.	1,807	1,562	1,636	506	5,511
May	3,500	376	1,430	357	5,663
June	6,030	726	1,541	389	8,686
July	5,212	870	1,275	472	7,829
Aug.	7,727	837	1,454	386	9,567
Sept.	8,598	526	1,946	602	11,672
Oct.	7,888	1,041	1,748	444	11,121
Nov.	7,786	894	1,824	306	10,810
Dec.	7,282	1,305	1,862	442	10,891
Total	60,704	9,895	18,098	4,593	93,290
1956					
Jan.*	7,534	1,100	1,843	374	10,851

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1945	3,886	14,500	6,800	....	21,300	25,186
1946	5,714	23,500	13,000	....	36,500	42,214
1947	13,909	22,500	6,500	....	29,000	42,909
1948	28,489	21,500	5,250	....	26,750	55,239
1949	36,117	21,500	3,750	....	25,250	61,367
1950	56,138	31,000	5,500	....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954						
Jan.	5,882	3,475	615	275	4,365	10,247
Feb.	5,595	3,568	575	250	4,393	9,988
Mar.	6,610	3,982	729	335	5,046	11,656
Apr.	5,892	3,748	603	324	4,675	10,567
May	5,969	3,394	586	348	4,328	10,297
June	5,884	3,653	629	402	4,684	10,568
July	4,298	2,587	482	296	3,365	7,663
Aug.	5,228	2,834	561	351	3,746	8,974
Sept.	6,903	3,599	628	379	4,606	11,509
Oct.	7,527	4,347	612	376	5,335	12,862
Nov.	7,622	4,411	631	411	5,453	13,075
Dec.	7,671	4,575	600	460	5,635	13,306
Yr.-end adj.	+350	....	....	+300	....	....
Total	75,931	44,173	7,251	4,507	55,931	131,862
1955						
Jan.	7,355	4,537	661	509	5,707	13,062
Feb.	7,066	4,881	689	505	6,075	13,141
Mar.	8,415	5,861	828	512	7,201	15,616
Apr.	7,732	5,209	748	606	6,563	14,295
May	6,643	4,278	768	496	5,542	12,185
June	6,589	4,885	722	591	6,198	12,787
July	5,469	3,830	535	430	4,795	10,264
Aug.	6,784	4,514	770	547	5,831	12,615
Sept.	7,452	5,505	730	595	6,830	14,282
Oct.	7,209	5,704	739	614	7,057	14,266
Nov.	6,620	5,954	829	603	7,386	14,006
Dec.	6,344	5,599	717	587	6,903	13,247
Yr.-end adj.	+2,800	+2,775	....	+1,900	+4,675	+7,475
Total	86,478	63,982	8,736	8,495	81,213	167,691
1956						
Jan.†	6,567	6,126	781	725	7,632	14,199

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
† Preliminary.
* Includes S-Types.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

	Shipments					
Year	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1951	32,151	32,284	1,071	65,507	67,249	10,094
1952	29,451	32,985	1,014	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954	25,090	35,442	948	61,480	58,397	
1955						
Jan.	413	3,629	74	4,116	3,089	8,252
Feb.	352	2,430	80	2,862	2,850	8,243
Mar.	491	2,732	105	3,328	3,234	8,217
Apr.	530	2,635	85	3,250	2,836	7,963
May	531	2,617	85	3,233	3,005	7,735
June	477	3,003	85	3,565	3,136	7,326
July	475	2,915	60	3,450	2,768	6,664
Aug.	394	3,274	65	3,733	2,923	5,917
Sept.	360	2,814	86	3,261	3,169	5,966
Oct.	319	2,595	89	3,004	3,119	6,286
Nov.	355	2,427	93	2,875	3,052	6,734
Dec.	305	2,289	92	2,686	2,719	6,833
Total	5,002	33,360	999	39,363	35,900	
1956						
Jan.	274	3,263	72	3,608	2,918	6,294

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Sales and Inventories

(Million of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1952	1953	1954	1955	1952	1953	1954	1955
Jan.	408	424	348	424	809	866	844	790
Feb.	402	435	351	440	842	868	857	782
Mar.	400	473	388	466	857	880	849	805
Apr.	407	444	375	445	850	874	812	784
May	402	422	357	465	855	888	810	810
June	409	436	377	465	851	914	829	850
July	377	448	374	471	890	925	784	853
Aug.	388	409	337	456	877	897	761	863
Sept.	427	416	334	456	871	908	804	874
Oct.	423	395	332	447	866	881	838	902
Nov.	383	346	388	482	850	867	819	935
Dec.	418	369	407	476	877	868	929	896
Total	4,844	5,017	4,368	5,493	Av. 858	853	831	845

Source: Office of Business Economics, U. S. Department of Commerce.
* Adjusted for seasonal variation.

World Position of Natural Rubber Since 1935

Year	Total Production*	Total Consumption	Total Stocks	N. Y. Average Price—¢
1935	830,000	940,000	....	12.32
1936	867,500	1,045,000	....	16.43
1937	1,210,000	1,090,000	745,000	19.37
1938	910,000	955,000	707,500	14.56
1939	1,000,000	1,105,000	582,500	17.47
1940	1,417,500	1,110,000	880,000	19.90
1941	1,600,000	1,240,000	1,230,000	22.11
1942	640,000	765,000	1,020,000	22.50
1943	465,000	615,000	820,000	22.50
1944	360,000	387,500	715,000	22.50
1945	250,000	262,500	660,000	22.50
1946	837,500	555,000	940,000	22.50
1947	1,260,000	1,110,000	845,000	20.97
1948	1,525,000	1,422,500	770,000	22.01
1949	1,490,000	1,437,500	720,000	17.56
1950	1,860,000	1,705,000	767,500	41.10
1951	1,885,000	1,497,500	812,500	‡59.07
1952	1,790,000	1,455,000	822,500	§38.57
1953	1,725,000	1,630,000	830,000	24.50
1954	1,802,500	1,765,000	845,000	23.87
1955	1,895,000	1,830,000	885,000	39.55

Production consumption and stock figures are in long tons and include latex (dry rubber content).
* Net exports up to and including 1936.
‡ Average of U.S. Government's selling price from January 8, 1951, onward.
§ Average of U.S. Government's selling price until June 30, 1952, New York spot closing prices thereafter.
Source: "Rubber Statistical Bulletin" of International Rubber Study Group.

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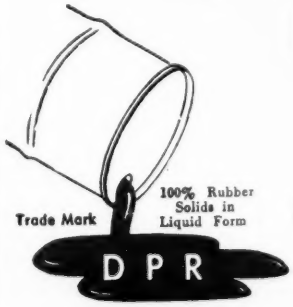

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World Production ot Natural Rubber

(1,000 Long Tons)

Year	Malaya		Indonesia		All Other	Total
	Estate	Native	Estate	Native		
1948	403.6	294.6	101.7	330.6	394.5	1,525.0
1949	400.8	270.7	169.1	263.9	385.5	1,490.0
1950	376.7	317.4	175.1	521.4	469.4	1,860.0
1951	328.8	276.5	222.5	591.9	465.3	1,885.0
1952	341.7	242.5	293.2	456.0	456.6	1,790.0
1953	341.8	232.6	301.8	390.4	458.4	1,725.0
1954						
Jan.	30.3	19.1	24.2	34.9	44.0	152.5
Feb.	25.4	18.0	23.0	30.2	30.9	127.5
Mar.	24.6	17.5	23.2	36.7	35.5	137.5
Apr.	24.8	15.4	21.2	37.0	34.1	132.5
May	27.6	18.6	22.9	32.9	30.5	132.5
June	27.0	16.3	21.0	33.5	39.7	137.5
July	31.0	23.0	26.8	46.2	38.0	165.0
Aug.	30.9	21.6	21.9	37.1	38.5	150.0
Sept.	30.1	23.4	23.6	46.4	41.5	165.0
Oct.	29.5	20.8	23.9	45.6	40.2	160.0
Nov.	31.9	22.9	24.3	36.8	46.6	162.5
Dec.	30.4	24.2	24.5	47.0	53.9	180.0
Total	343.5	240.8	280.5	464.3	473.4	1,802.5
1955*						
Jan.	29.3	27.9	23.6	17.1	42.1	140.0
Feb.	28.5	20.4	22.3	48.1	38.2	157.5
Mar	27.5	26.7	23.0	23.8	39.0	140.0
Apr.	24.2	20.5	20.7	27.4	42.2	135.0
May	27.4	22.4	18.0	30.1	37.1	135.0
June	27.6	22.9	21.3	52.7	40.5	165.0
July	30.3	25.7	21.2	32.5	55.3	165.0
Aug.	30.7	23.6	20.0	43.2	37.5	155.0
Sept.	31.3	24.9	20.3	45.2	45.8	167.5
Oct.	30.8	24.0	22.0	44.8	48.4	170.0
Nov.	30.3	21.9	23.4	37.3	44.6	157.5
Dec.	35.0	27.3	24.5	70.2	50.5	207.5
Total	352.9	286.2	261.3	472.4	521.2	1,895.0

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.
* Some figures revised.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany*	Total
1947	508.7	42.4	8.2	559.3
1948	488.3	40.5	3.4	532.2
1949	393.7	46.6	....	440.3
1950	476.2	58.4	....	534.6
1951	845.2	62.3	0.9	908.4
1952	798.6	74.3	4.9	877.8
1953	848.4	80.9	6.3	935.6
1954				
Jan.	57.3	7.3	0.4	65.0
Feb.	53.4	6.7	0.4	60.5
Mar.	55.8	7.4	0.5	63.7
Apr.	47.6	7.1	0.6	55.3
May	46.6	7.3	0.5	54.4
June	45.9	5.9	0.5	52.3
July	47.0	5.8	0.5	53.3
Aug.	48.8	7.3	0.7	56.8
Sept.	51.4	7.9	0.6	59.9
Oct.	55.6	8.0	0.6	64.2
Nov.	55.0	8.0	0.7	63.7
Dec.	58.5	7.9	0.9	67.3
Total	622.9	86.6	6.9	716.4
1955				
Jan.	69.9	8.1	0.9	78.9
Feb.	67.7	7.6	0.9	76.2
Mar.	78.5	8.7	0.8	88.0
Apr.	75.7	7.6	0.8	84.1
May	82.0	8.9	0.9	91.7
June	78.2	8.6	0.9	87.7
July	81.9	8.2	0.9	91.0
Aug.	84.0	8.1	1.0	93.1
Sept.	83.5	9.3	0.9	93.7
Oct.	89.1	9.9	1.0	100.0
Nov.	91.3	9.2	1.0	101.5
Dec.	90.3	9.7	....	....
Total	970.5	103.9	....	....

Source: Secretariat of the International Rubber Study Group; and BDSA, United States Department of Commerce.
* British Zone only for 1947; Bizone for 1948 and 1949; Federal Republic since 1950.

World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	U.S.S.R.* and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1948	627.3	121.0	193.7	480.5	795.2	1,422.5
1949	574.5	132.5	184.3	546.2	863.0	1,437.5
1950	720.3	152.5	219.7	612.5	984.7	1,705.0
1951	454.0	136.3	234.2	675.5	1,046.0	1,500.0
1952	453.8	146.8	197.3	652.1	996.2	1,450.0
1953	553.5	101.9	206.6	753.0	1,061.5	1,615.0
1954						
Jan.	47.0	7.8	20.3	67.4	95.5	142.5
Feb.	46.9		17.5	70.6	88.1	135.0
Mar.	53.7	2.7	19.1	72.0	93.8	147.5
Apr.	51.4	15.5	19.7	68.4	103.6	155.0
May	51.4	1.1	18.8	66.2	86.1	137.5
June	54.2	3.6	18.0	64.1	85.7	140.0
July	37.9	0.8	17.7	68.6	87.1	125.0
Aug.	38.1	8.9	14.2	63.8	86.9	125.0
Sept.	52.4	11.5	19.3	71.8	102.6	155.0
Oct.	56.0	3.5	23.1	74.9	101.5	157.5
Nov.	53.3	2.3	19.2	75.2	96.7	150.0
Dec.	55.2	5.0	19.6	72.7	97.3	152.5
Total	597.5	62.7	226.5	835.7	1,124.9	1,725.0
1955						
Jan.	56.9	7.8	23.5	71.8	103.1	160.0
Feb.	51.0	....	20.1	....	89.0	140.0
Mar.	58.5	7.3	21.4	72.8	101.5	160.0
Apr.	53.0	....	23.3	....	104.5	157.5
May	54.7	....	20.5	....	97.8	152.5
June	56.3	2.8	18.3	80.1	101.2	157.5
July	46.2	1.8	18.3	73.7	93.8	140.0
Aug.	48.4	0.1	16.0	65.5	81.6	130.0
Sept.	51.0	2.1	19.8	72.1	94.0	145.0
Oct.	55.0	10.4	22.9	76.7	110.0	165.0
Nov.	52.8	17.1	20.0	77.6	114.7	167.5
Dec.	48.6	5.2	22.2	79.0	106.4	155.0
Total	632.4	....	246.3	....	1,197.6	1,830.0

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.
* Estimated.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdom	Total† Continent of Europe	World† Grand Total
1947	559.7	29.2	2.8	32.5	625.0
1948	442.1	20.6	2.6	15.0	480.0
1949	414.4	18.1	2.4	14.0	450.0
1950	538.3	22.6	2.8	16.0	580.0
1951	758.9	26.4	3.9	22.3	812.5
1952	807.0	33.6	4.9	35.0	885.0
1953	784.8	35.9	4.9	39.3	872.5
1954					
Jan.	50.2	2.6	0.6	3.8	57.5
Feb.	49.1	3.0	0.5	4.0	57.5
Mar.	56.1	2.9	0.7	4.3	65.0
Apr.	53.6	2.7	0.8	4.0	62.5
May	52.6	2.7	0.7	4.0	60.0
June	57.2	2.8	0.7	4.3	67.5
July	41.5	1.9	0.6	4.3	50.0
Aug.	42.1	2.0	0.7	3.5	47.5
Sept.	53.9	2.4	0.8	4.5	62.5
Oct.	58.3	2.1	1.0	4.3	67.5
Nov.	57.3	2.6	0.8	4.5	65.0
Dec.	64.1	2.4	0.8	4.5	72.5
Total	636.7	30.1	8.7	50.8	740.0
1955					
Jan.	68.4	2.6	1.2	5.8	80.0
Feb.	67.6	3.1	1.1	5.5	77.5
Mar.	77.1	3.4	1.2	6.0	90.0
Apr.	72.1	3.0	1.5	5.8	85.0
May	75.7	3.3	1.4	6.0	87.5
June	80.2	3.8	1.5	6.5	92.5
July	63.3	2.7	1.4	6.3	75.0
Aug.	73.3	2.7	1.5	6.3	87.5
Sept.	76.7	3.7	1.9	7.0	92.5
Oct.	80.4	3.6	2.6	7.5	97.5
Nov.	81.7	4.4	2.4	7.8	97.5
Dec.	75.9	4.0	2.7	7.3	92.5
Total	890.4	40.2	20.5	77.5	1,055.0

Source: Secretariat of the International Rubber Study Group; BDSA, United States Department of Commerce.
* Includes latices.
† Figures estimated or partly estimated.

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A large firm engaged in the manufacture of elastomers needs a number of chemists and chemical engineers holding AB or MS degrees who are interested in technical sales service and development. Two to three years experience in the rubber industry is very desirable but not essential.

If you want this type of work, you will find this a real opportunity. (Our employees know of this advertisement.)

ADDRESS BOX NO. 1899
c/o RUBBER WORLD

CHEMICAL SUPPLIER TO RUBBER AND LATEX INDUSTRIES overseas requires technical salesman. Compounding experience necessary. Overseas traveling required periodically. Excellent future prospects for right man. Office located in New York City. Address Box No. 1902, care of RUBBER WORLD.

OPENING IN LABORATORY OF SUPPLIER OF CHEMICALS to rubber and plastics industries for man 30 or under with five years of general rubber compounding experience. Opportunity for advancement. Location: New England. Address Box No. 1903, care of RUBBER WORLD.

WANTED: ADHESIVE-TAPE CALENDER OPERATOR AND compounder to take responsibility for new department in growing diversified company in the South. Give complete biography and references. All replies confidential. Address Box No. 1904, care of RUBBER WORLD.

RUBBER TECHNICIAN NEEDED BY EASTERN CONNECTICUT MANUFACTURER

Experience in compounding and molding of products made from most of the commercial polymers essential. Fast-growing company, well-equipped laboratory. Above-average opportunity for a man with ability to get things done. Send résumé stating education and experience. Replies held confidential. Address Box No. 1905, care of RUBBER WORLD.

MARKETING OPPORTUNITIES IN SALES AND SALES DEvelopment for chemist or chemical engineer at B.S. level, preferably with background in rubber or polymer field. Write details to P. O. Box 216, Torrance, California.

VINYL CHEMIST

Leading flooring manufacturer in New Jersey has opening for chemist with experience in compounding and factory processing of vinyl resin. Experience in flooring preferred, but not essential. Excellent opportunity for right man. Write giving details of education, experience, and salary requirement. All replies confidential. Our employes know of this ad. Address Box No. 1906, care of RUBBER WORLD.

ASSISTANT PLANT ENGINEER

Permanent position for graduate mechanical engineer with some experience in rubber industry. To assist plant engineer in various phases of project engineering, maintenance, etc. A permanent career with a leading, well-established rubber company in New Jersey. Write giving details of education, experience, and salary required. All replies confidential. Our employes know of this ad. Address Box No. 1907, care of RUBBER WORLD.

SITUATIONS OPEN (Continued)

WANTED

MANUFACTURER'S AGENT for line of Neoprene and Hypalon protective coatings. Eastern seaboard and midwestern states. Address Box 1901, care of RUBBER WORLD.

RUBBER CHEMIST. MIDWEST "O" RING AND PACKING manufacturer needs experienced rubber chemist over 30 to head small research, development, and control laboratory. Will plan, direct, and conduct research projects on new or present rubber products. Must be able to lead and inspire group successfully. Salary commensurate with responsibility. Reply fully to Box No. 1908, care of RUBBER WORLD.

WELL-ESTABLISHED EXPANDING COMPANY IN PLEASANT surroundings needs a rubber chemist experienced in formulating and compounding natural and all synthetic rubber polymers, preferably in wire and cable industry. Must be willing and able to trouble-shoot in production. Submit résumé of experience and salary requirements with first letter. Address Box No. 1909, care of RUBBER WORLD.

RUBBER CHEMIST

Chemist or Chemical Engineer with up to five years' experience in synthetic rubber compounding needed for development assignment on a wide range of flooring or mechanical goods. Laboratory as well as follow-through in pilot and production plans. Reply sending details of age, experience, education, salary needs, etc., to Personnel Administration Department, Armstrong Cork Company, Lancaster, Pennsylvania.

ADHESIVE-CHEMIST

Chemist or Chemical Engineer with experience or interest in adhesives or allied materials—rubbers, resins, etc.—needed for adhesives research and development assignment in Lancaster, Pennsylvania. Write giving age, experience, education, salary needs to Personnel Administration Department, Armstrong Cork Company, Lancaster, Pennsylvania.

LATEX CHEMIST FAMILIAR WITH LATEX COMPOUNDING for coagulant dipping process and having experience in development work. Send complete details to ELASTOMERS, INC., P. O. Box 1750, Fort Myers, Florida.

WANTED: TAPE CHEMIST TO HEAD UP DEVELOPMENT and control of manufacturing processes on pressure-sensitive tapes, with primary emphasis on Vinyl-supported adhesive tapes. Applicant should hold C.E. or B.S. Degree and have at least two yrs.' experience in this field. Write giving full details of experience, salary, etc. This is a sound, long-range program with old-established company. No price—firmly established—but salary will be commensurate with ability. Address Box No. 1910, care of RUBBER WORLD.

RUBBER CHEMIST OR COMPOUNDER

Preferably with Rubber Flooring and Slab-Sole Stock experience. Knowledge of Vinyl Compounding and Processing would be desirable. Must be willing to relocate. Give complete biography, references, and salary requirements. Address Box No. 1911, care of RUBBER WORLD.

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TOP-LEVEL TIRE MANUFACTURING SUPERINTENDENT:

Large Midwest plant has excellent opportunity for man whose training and experience qualify him as Tire Manufacturing Superintendent. Applications confidential. State age, experience, other pertinent information. Suggest recent photograph.

REPLY BOX No. 1900, c/o RUBBER WORLD

U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1953	33,106	45,798	809	79,713	81,455	13,044
1954	29,746	47,043	928	77,717	76,806	12,228
1955						
Jan.	3,481	4,139	79	7,699	7,797	12,363
Feb.	3,540	3,551	83	7,174	7,549	12,643
Mar.	4,326	4,255	104	8,685	8,810	12,874
Apr.	3,967	4,677	88	8,733	8,000	12,197
May	3,871	4,705	87	8,663	8,742	12,235
June	3,482	5,399	97	8,979	9,383	12,698
July	3,461	4,802	76	8,339	7,893	12,199
Aug.	2,984	5,058	60	8,103	7,585	11,636
Sept.	2,749	4,366	74	7,189	7,882	12,407
Oct.	3,172	3,556	74	6,802	8,160	13,806
Nov.	3,900	2,902	63	6,865	8,198	15,142
Dec.	3,641	2,746	81	6,467	7,223	15,963
Total	42,574	50,156	966	93,698	97,232	
1956						
Jan.	2,958	4,040	66	7,064	7,661	16,546
Truck and Bus						
1953	4,843	9,326	734	14,904	14,696	2,676
1954	3,592	8,111	826	12,529	12,347	2,546
1955						
Jan.	303	827	81	1,211	1,243	2,586
Feb.	294	730	74	1,098	1,196	2,678
Mar.	454	672	96	1,222	1,273	2,734
Apr.	489	639	76	1,204	1,153	2,693
May	481	655	65	1,202	1,208	2,701
June	449	730	76	1,255	1,320	2,763
July	429	909	51	1,389	1,134	2,485
Aug.	378	922	59	1,359	1,132	2,272
Sept.	393	804	66	1,264	1,243	2,268
Oct.	324	904	88	1,315	1,395	2,357
Nov.	403	690	87	1,180	1,405	2,584
Dec.	404	552	91	1,047	1,255	2,815
Total	4,801	9,034	910	14,746	14,957	
1956						
Jan.	444	629	65	1,139	1,318	2,971
Total Automotive						
1953	37,949	55,124	1,543	94,617	96,150	15,720
1954	33,338	55,154	1,754	90,246	89,153	14,774
1955						
Jan.	3,785	4,967	159	8,911	9,040	14,949
Feb.	3,833	4,281	157	8,272	8,745	15,321
Mar.	4,780	4,926	201	9,907	10,083	15,609
Apr.	4,457	5,315	165	9,937	9,153	14,890
May	4,352	5,361	152	9,865	9,949	14,936
June	3,931	6,129	174	10,234	10,703	15,460
July	3,890	5,711	128	9,729	9,027	14,684
Aug.	3,362	5,980	119	9,462	8,717	13,908
Sept.	3,142	5,171	140	8,453	9,125	14,675
Oct.	3,495	4,460	161	8,117	9,555	16,163
Nov.	4,303	3,592	150	8,045	9,603	17,727
Dec.	4,045	3,298	172	7,515	8,478	
Total	47,375	59,191	1,878	108,447	112,178	
1956						
Jan.	3,402	4,669	131	8,203	8,979	

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1953	$87.29	40.6	$2.15
1954	90.76	40.7	2.23
1955			
Jan.	93.02	40.8	2.28
Feb.	93.07	41.0	2.27
Mar.	94.12	41.1	2.29
Apr.	99.53	42.9	2.32
May	95.22	41.4	2.30
June	96.51	41.6	2.32
July	97.53	41.5	2.35
Aug.	99.96	42.0	2.38
Sept.	100.08	41.7	2.40
Oct.	98.83	41.7	2.37
Nov.	99.30	41.9	2.37

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumers Price Index
		All Rubber Products			
1939	121	$27.84	39.9	$0.75	....
1952	212	74.48	40.7	1.83	113.5
1953	221	77.78	40.3	1.93	114.4
1954					
Sept.	198.9	77.81	39.3	1.98	114.7
Oct.	204.2	81.20	40.4	2.01	114.5
Nov.	204.6	83.02	41.1	2.02	114.6
Dec.	209.3	85.07	41.7	2.04	114.3
1955					
Jan.	210.5	84.25	41.3	2.04	114.3
Feb.	210.4	84.25	41.3	2.04	114.3
Mar.	211.2	83.44	40.9	2.04	114.3
Apr.	211.6	86.11	41.8	2.06	114.2
May	214.4	86.94	41.8	2.08	114.2
June	220.0	88.83	42.3	2.10	114.4
July	216.9	86.52	41.2	2.10	114.7
Aug.	219.0	86.32	41.3	2.09	114.5
Sept.	223.1	86.74	41.5	2.09	114.9
Oct.	226.4	89.04	42.0	2.12	114.9
Nov.	231.4	92.44	42.6	2.17	115.0
Dec.	232.8	....	....	....	114.7
		Tires and Tubes			
1939	54.2	$33.36	35.0	$0.96	
1952	92.9	85.65	40.4	2.12	
1953	93.0	88.31	39.6	2.23	
1954					
Sept.	85.2	86.18	38.3	2.25	
Oct.	86.5	90.39	39.3	2.30	
Nov.	83.7	94.54	40.4	2.34	
Dec.	87.0	98.18	41.6	2.36	
1955					
Jan.	87.6	97.41	41.1	2.37	
Feb.	86.5	96.46	40.7	2.37	
Mar.	87.4	95.27	40.2	2.37	
Apr.	88.4	101.28	42.2	2.40	
May	90.1	100.91	41.7	2.42	
June	91.0	105.60	43.1	2.45	
July	91.5	103.82	42.7	2.42	
Aug.	91.0	102.72	42.1	2.44	
Sept.	91.9	101.02	41.4	2.44	
Oct.	92.3	103.74	42.0	2.47	
Nov.	93.5	107.95	42.5	2.54	
		Rubber Footwear			
1939	14.8	$22.80	37.5	$0.61	
1952	22.9	62.22	40.4	1.54	
1953	23.7	65.60	40.0	1.64	
1954					
Sept.	21.0	66.08	39.1	1.69	
Oct.	21.9	71.34	41.0	1.74	
Nov.	22.3	71.51	41.1	1.74	
Dec.	22.3	71.69	41.2	1.74	
1955					
Jan.	22.1	68.97	40.1	1.72	
Feb.	21.5	69.72	40.3	1.73	
Mar.	21.4	69.72	40.3	1.73	
Apr.	21.2	70.99	40.8	1.74	
May	21.4	70.64	40.6	1.74	
June	21.6	71.34	41.0	1.74	
July	21.8	71.93	41.1	1.75	
Aug.	21.5	67.25	39.1	1.72	
Sept.	23.5	67.60	39.3	1.72	
Oct.	24.5	69.20	40.0	1.73	
Nov.	25.5	77.89	42.1	1.85	
		Other Rubber Products			
1939	51.9	$23.34	38.9	$0.61	
1952	96.0	66.58	41.1	1.62	
1953	104.1	70.93	41.0	1.73	
1954					
Sept.	92.7	72.36	40.2	1.80	
Oct.	95.8	74.98	41.2	1.82	
Nov.	98.6	75.71	41.6	1.82	
Dec.	100.0	76.44	42.0	1.82	
1955					
Jan.	100.8	76.08	41.8	1.82	
Feb.	101.4	76.86	42.0	1.83	
Mar.	102.4	76.13	41.6	1.83	
Apr.	101.1	76.13	41.6	1.83	
May	105.0	78.31	42.1	1.86	
June	106.4	77.93	41.9	1.86	
July	103.6	73.84	39.7	1.86	
Aug.	104.3	75.85	41.0	1.85	
Sept.	107.7	78.96	42.0	1.88	
Oct.	109.7	80.56	42.4	1.90	
Nov.	112.4	83.03	42.8	1.94	

Source: BLS, United States Department of Labor.

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Carbon Black Statistics—1955

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, semi-abrasion furnace black.

(Thousands of Pounds)

Production	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Furnace types													
Thermal	9,315	8,269	10,317	10,620	12,094	12,077	12,189	12,879	12,164	12,499	12,365	12,119	136,907
SRF	25,099	26,162	26,258	25,634	24,974	26,561	28,371	28,813	29,315	30,162	29,699	30,641	331,689
HMF	9,060	7,610	8,538	7,644	7,665	7,015	8,700	7,867	9,598	9,552	8,746	9,799	101,794
FEF	12,395	11,597	14,943	17,039	19,196	19,013	18,938	20,125	20,051	20,276	18,469	19,843	211,885
HAF	33,199	29,344	34,011	35,341	36,249	37,238	39,592	40,692	36,672	37,707	32,386	36,322	428,753
SAF	15,627	18,010	18,139	17,201	15,699	14,494	12,260	10,203	10,786	12,555	14,531	14,383	173,893
Total furnace	104,695	100,992	112,206	113,479	115,877	116,398	120,050	120,584	118,586	122,751	116,196	123,107	1,384,921
Contact types	29,693	27,153	30,750	31,676	30,559	30,238	30,466	30,141	29,717	30,724	30,797	32,182	364,096
Totals	134,388	128,145	142,956	145,155	146,436	146,636	150,516	150,725	148,303	153,475	146,993	155,289	1,749,017
Shipments													
Furnace types													
Thermal	8,209	9,756	11,957	10,659	12,150	12,426	11,490	11,121	11,986	12,663	12,295	11,617	136,329
SRF	26,411	26,851	27,654	28,722	27,508	27,808	26,742	25,394	28,124	28,146	29,425	27,543	330,328
HMF	8,318	8,399	10,089	8,834	9,129	9,532	8,288	8,241	8,818	9,242	8,508	8,302	105,700
FEF	15,737	16,801	19,144	18,139	18,641	17,068	16,179	17,103	17,954	19,603	19,967	18,533	214,869
HAF	32,602	32,373	35,163	34,764	35,505	35,548	33,872	36,865	34,161	36,861	38,060	34,506	420,280
SAF	14,069	13,754	15,431	15,721	15,108	14,491	14,160	11,625	14,375	15,251	16,474	12,965	173,424
Total furnace	105,346	107,934	119,438	116,839	118,041	116,873	110,731	110,349	115,418	121,766	124,729	113,466	1,380,930
Contact types	43,403	35,263	42,107	39,827	37,073	36,697	33,228	40,330	38,081	39,335	37,924	30,857	454,125
Totals	148,749	143,197	161,545	156,666	155,114	153,570	143,959	150,679	143,499	161,101	162,653	144,323	1,835,055
Producers' Stocks, End of Period													
Furnace types													
Thermal	6,513	5,026	3,386	3,347	3,291	2,942	3,641	5,399	5,577	5,413	5,483	5,985	
SRF	16,466	15,777	14,381	11,293	8,759	7,512	9,141	12,560	13,751	15,767	16,041	19,139	
HMF	25,004	24,215	22,664	21,474	20,010	17,493	17,905	17,531	18,311	18,621	18,859	20,356	
FEF	23,204	18,000	13,799	12,699	13,254	15,199	17,958	20,980	23,077	23,750	22,252	23,562	
HAF	28,579	25,550	24,398	24,975	25,719	27,409	33,129	36,956	39,467	40,313	34,639	36,455	
SAF	28,340	32,596	35,304	36,784	37,375	37,378	35,478	34,061	30,472	27,776	25,833	27,251	
Total furnace	128,106	121,164	113,932	110,572	108,408	107,933	117,252	127,487	130,655	131,640	123,107	132,748	
Contact types	172,647	164,537	153,180	145,029	138,515	132,056	129,294	119,105	110,741	102,130	95,003	96,328	
Totals	300,753	285,701	267,112	255,601	246,923	239,989	246,546	246,592	241,396	233,770	218,110	229,076	
Exports													
Furnace types	18,318	21,137	23,392	22,234	21,165	20,805	20,413	19,985	20,728	19,282	22,173	22,831	252,463
Contact types	15,973	15,583	19,083	19,175	16,256	15,973	15,252	19,529	17,369	16,501	15,962	15,071	201,718
Totals	34,291	36,720	42,475	41,409	37,421	36,778	35,665	39,514	38,097	35,783	38,135	37,902	454,181

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

CALENDAR of COMING EVENTS

April 17
Elastomer & Plastics Group, Northeastern Section, ACS.

April 26-27
American Institute of Electrical Engineers. National Meeting. Bradford Hotel, Boston, Mass.

April 27
Chicago Rubber Group. Furniture Club, Chicago, Ill.

May 1
The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif.

May 6-9
American Institute of Chemical Engineers. Roosevelt Hotel, New Orleans, La.

May 11
Buffalo Rubber Group. International Meeting.

May 14-17
Design Engineering Conference and Design Engineering Show. Convention Hall, Philadelphia, Pa.

May 15
Elastomer & Plastics Group, Northeastern Section, ACS. Fifth Annual Short Talks Symposium.

May 16-18
Division of Rubber Chemistry, ACS. Hotel Cleveland, Cleveland, O.

May 25
Connecticut Rubber Group. Reclaimed Rubber Symposium.

May 28-30
Chemical Institute of Canada. Thirty-Ninth Annual Conference & Exhibition. Mt. Royal Hotel, Montreal, P.Q., Canada.

June 3-8
Society of Automotive Engineers. Annual Meeting. Chalfonte-Haddon Hall, Atlantic City, N. J.

June 7
New York Rubber Group. Outing. Doerr's Grove, Millburn, N. J.
Rhode Island Rubber Club. Outing.

June 13
Buffalo Rubber Group. Outing.

June 15
Akron Rubber Group. Outing. Firestone Country Club, Akron, O.
Boston Rubber Group. Outing. Andover Country Club, Andover, Mass.

June 17-21
American Society of Mechanical Engineers. Semi-Annual Meeting. Hotel Statler, Cleveland, O.

June 17-22
American Society for Testing Materials. Annual Meeting and Twelfth Exhibit of Testing & Scientific Apparatus & Laboratory Supplies. Chalfonte-Haddon Hall, Atlantic City, N. J.

June 20-21
Division of High-Polymer Physics, APS, and Division of Colloid Chemistry, ACS. Joint Symposium on "Diffusion" and "Flow Processes in Polymers." Madison, Wis.

July 21
Chicago Rubber Group. Outing.

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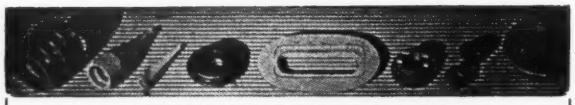

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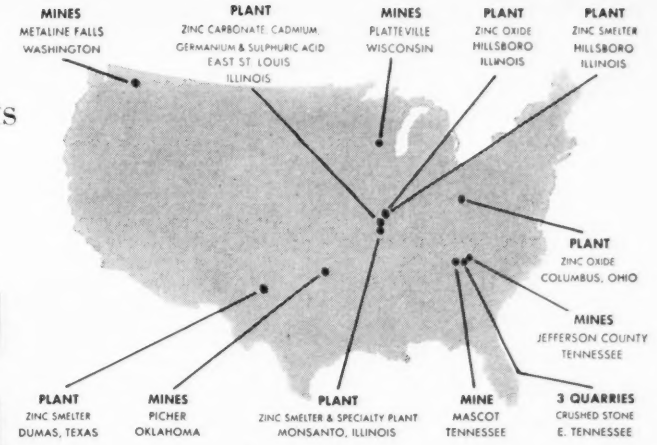

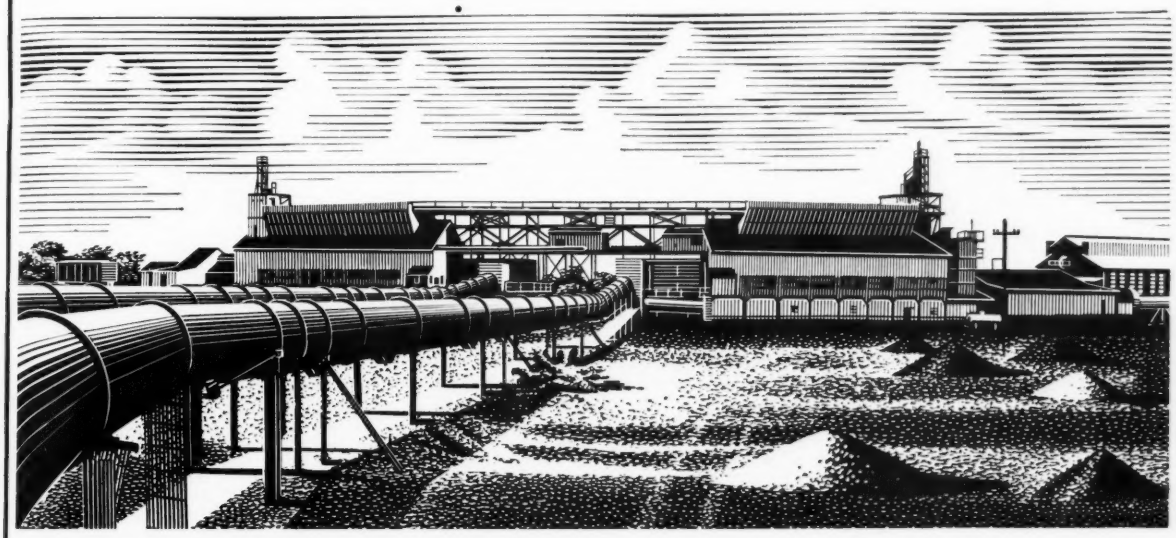

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